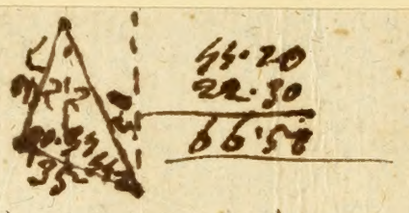
Mathematical copy Books
Belonging to Caleb White of Brookline
and his daughter Ann late wife of
Mr. John Goddard of Portsmouth N.H.

Caleb White, born in Brookline 10 March 1741
Son of Benjamin and Sarah (Aspinwall)
White.
He graduated at Princeton College 1762
Married Elizabeth Craft 14 may 1767
died in Brookline, 16 Dec. 1770–

From Est. of Miss Julia Goddard 1920.



Caleb White

his Book

November 6th

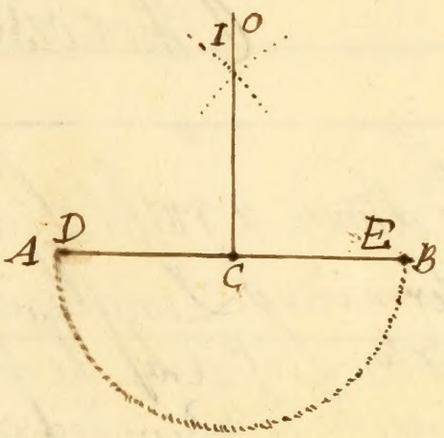
1760

Geometry.

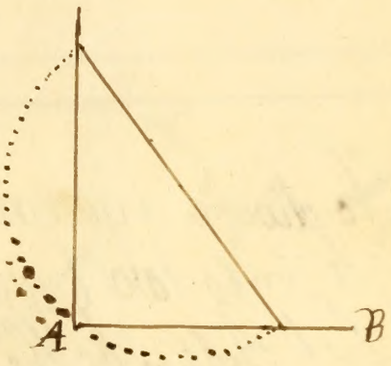
Is the Science of extention, & is employed in the consideration of Lines, Surfaces & Solids, as all Extention is distinguished into Length Breadth & Thickness.

Upon drawing of Lines

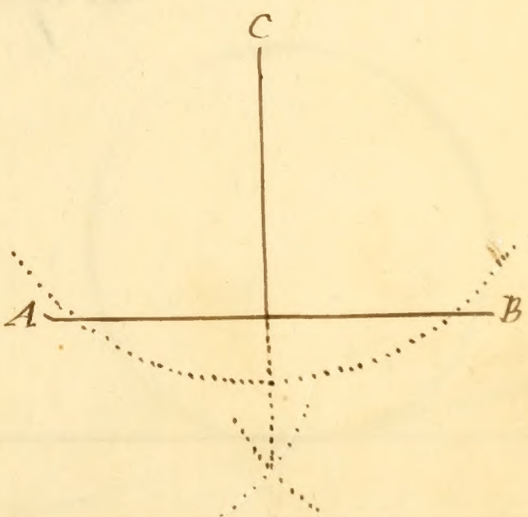
To raise a Perpendicular from a given Point in the middle of a right Line. let C be the given Point in the middle of the of the Line A B, upon which the Perpendicular is to be raised



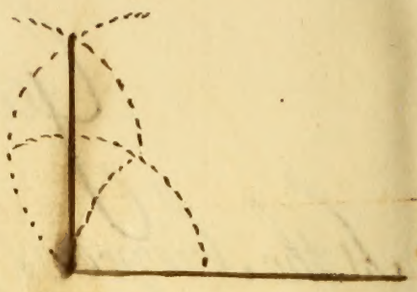
To raise a Perpendicular upon the Extremity of a right Line given. A B is the right Line given, at the extremity of which A, the Perpendicular is to be raised.



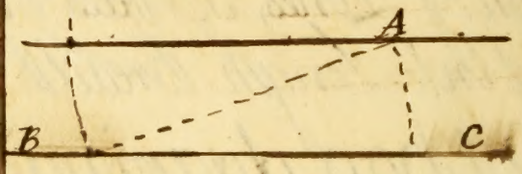
To bring down a Perpendicular Line upon a right Line given, & from a Point at a distance from the said right Line. let C be the Point from whence a Perpendicular Line is to be brought down upon the Line A B.



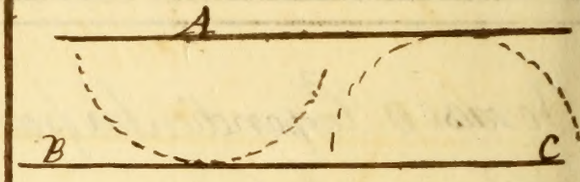
To raise a Perpendicular upon the Extremity of a Right Line given.



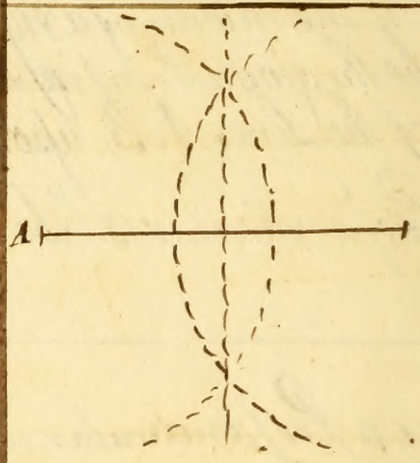
To draw a Line through a given Point, parralled to a Right Line given.
let a be the Point through which a line is to be drawn parralled to the Line BC



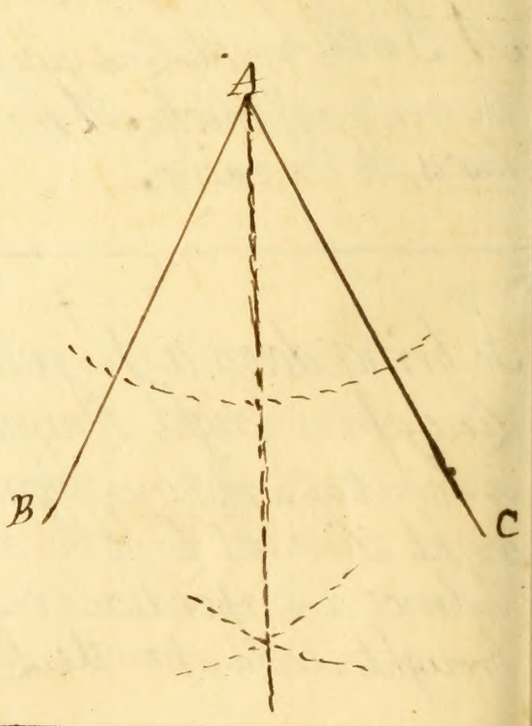
Otherwise



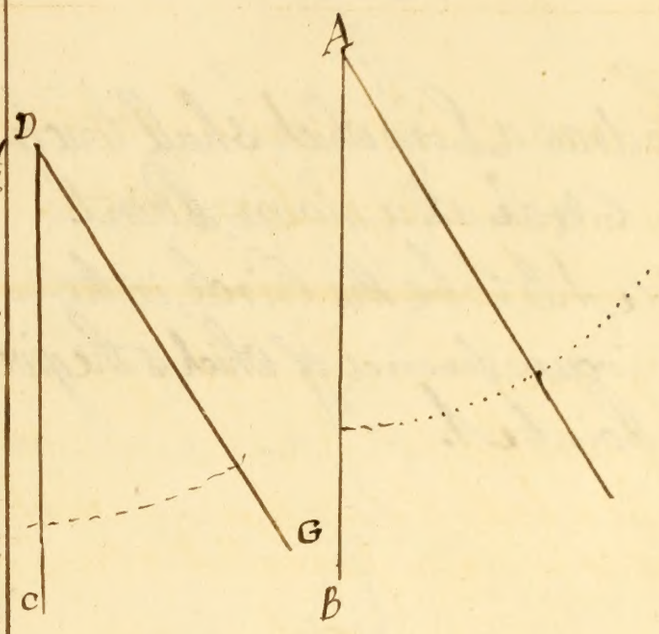
To divide a right Line given of a determined Length, into two equal parts, Let a be the propose Right Line, to be Divided equally in two.



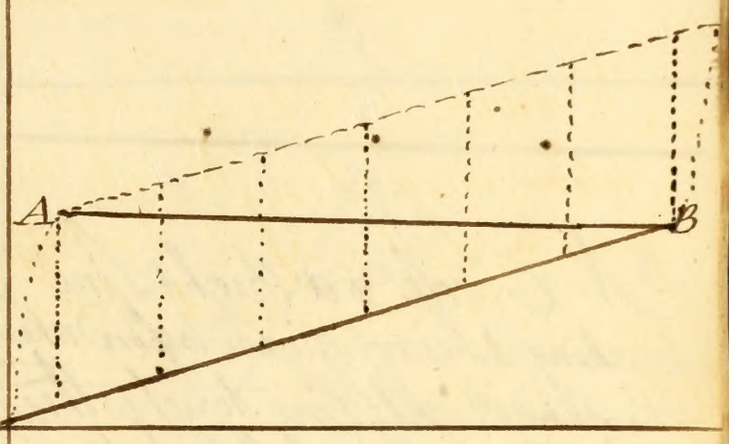
To divide a given Rectilinear Triangle into two Equal Lines Parts
Let BAC be the Angle proposed to be divided into two equal Parts.



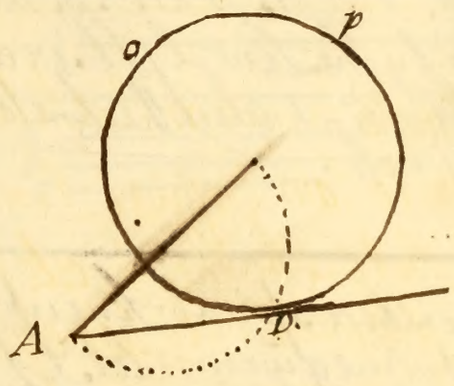
To make a Rectilinear Triangle Angle at the Extremity of a Right Line, equal to a Rectilinear Angle given. let A be ye Extremity of ye Line AB at which an Angle is to be made equal to the given Rectilinear Angle DG.

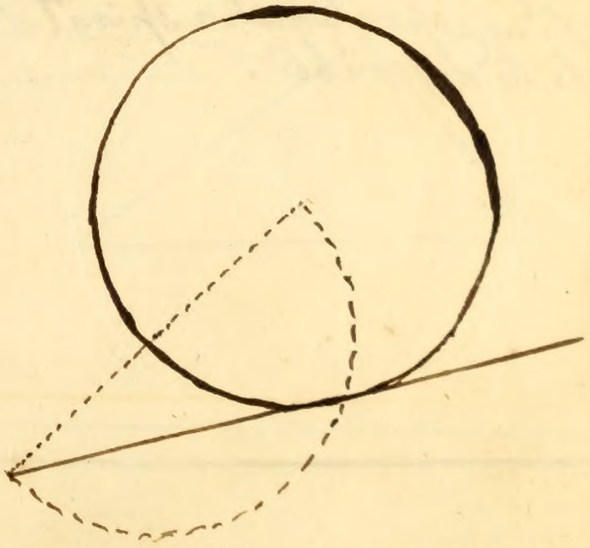


To divide a Right Line given into as many Parts as You. let AB be the Line proposed to be divided into six equal Parts



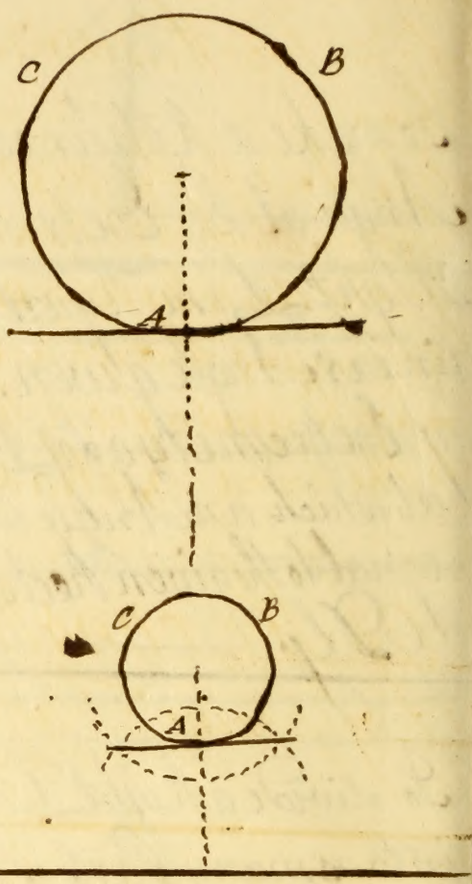
From a given Point, to draw a Right Line which shall touch a proposed Circle. let a be the Point from whence a Line is to be drawn that shall touch the Circle DOE.



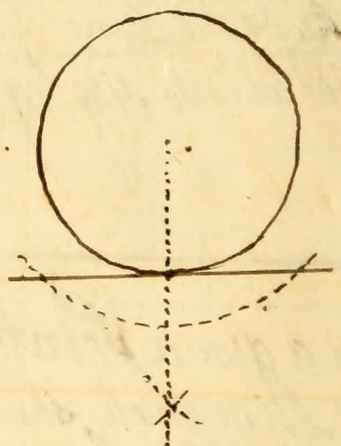


To draw a Line which shall touch a Circle at a given Point.

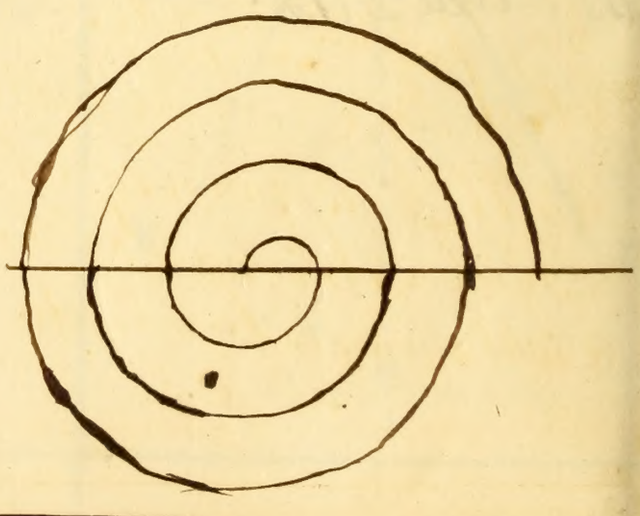
Let A B C be the Circle, in the Circumference of which is the given Point A.



A Circle & a Right Line touching it being given to find where the said Right Line touches the said Circle. Let A B C. be the Circle touched by the Line D F. we are to find the Point where the Line touches the Circle.

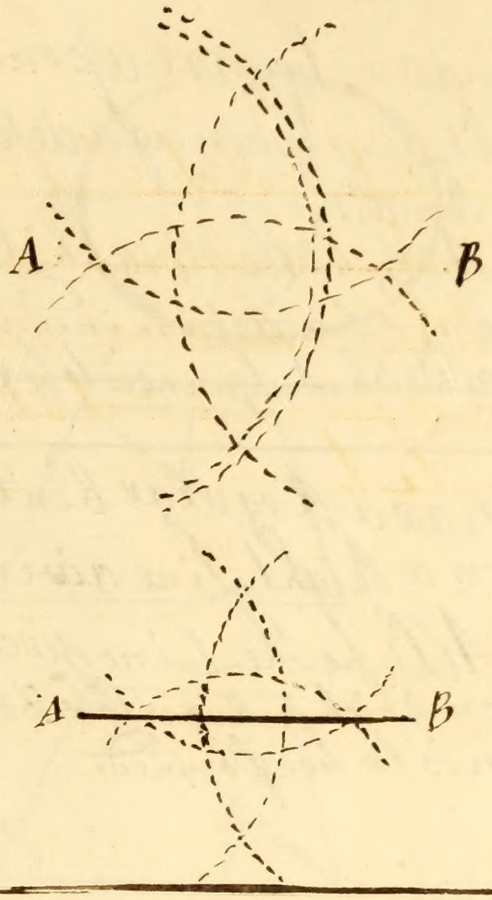


To discribe a spiral Line upon a Right Line given. Let F I be the Line upon which a spiral Line is to be described.



Between tow given Points to find two others directly between them

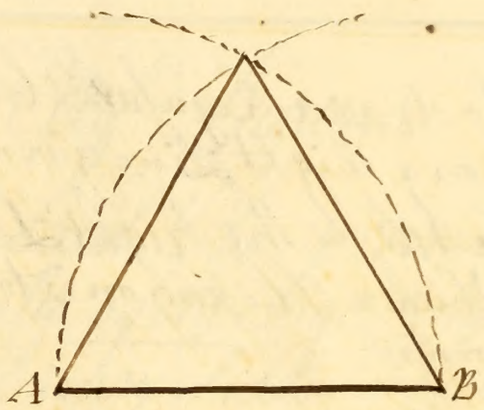
let A B. be the given Points, between which two others are to be found directly even with them & by means of which a Right Line may be drawn from the Point A to the Point B, with a short Ruler.



Of the construction of plaine Figures

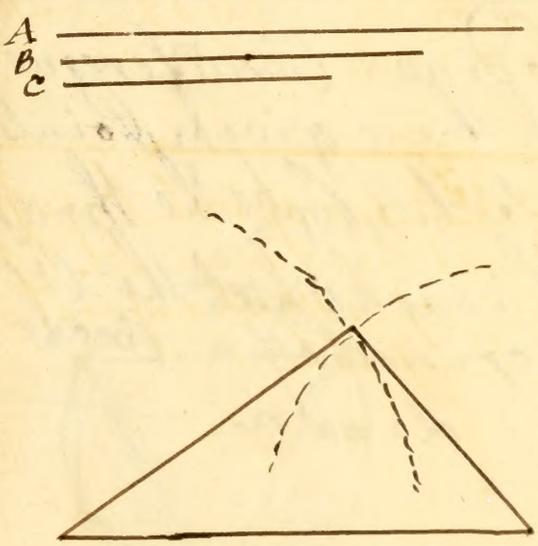
To construct an Equilateral Triangle upon a Right Line given of a determined length

let A B. be the Line upon which an Equilateral Triangle is to be formed.



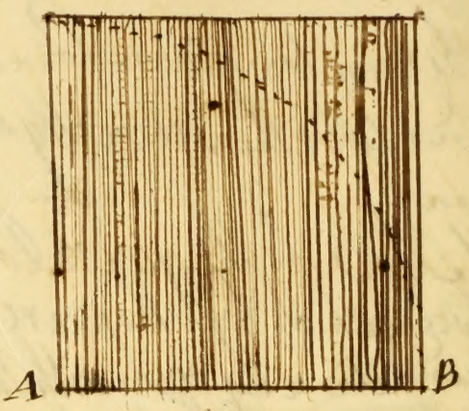
To make a Triangle of three Right Lines, equal to three Right Lines given.

let A, B, C, be the three Right Lines given equal to which a Triangle of three Right Lines is to be made.



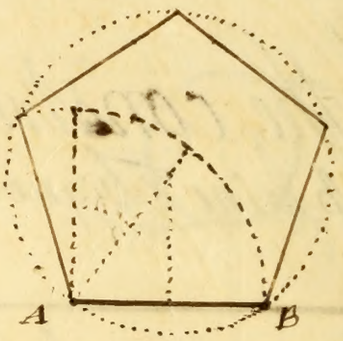
To draw a Square upon a Right Line given of a determined length.

let A B, be the Right Line given, of a determined length upon which a Square is to be formed.



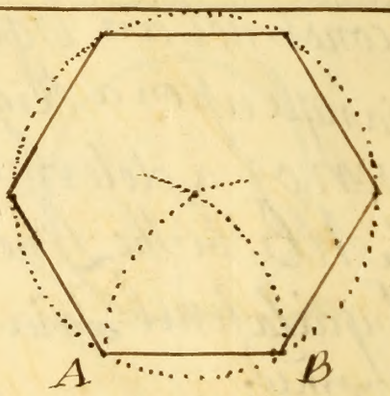
To draw a Regular Pentagon upon a Right Line given.

let A B, be the Line given upon which a Regular Pentagon is to be formed.



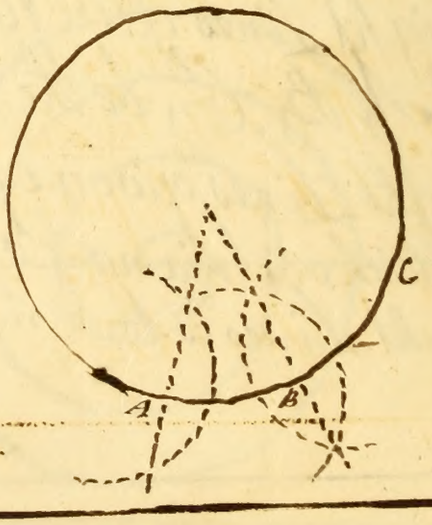
To draw a Regular Hexagon upon a Right Line given

let A B, be the Right Line upon which a Hexagon is to be formed.



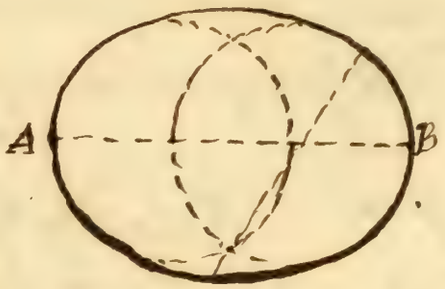
To draw a Circumference through three given Points.

let A, B, C, be the three Points through which the Circumference of a Circle is to be drawn.



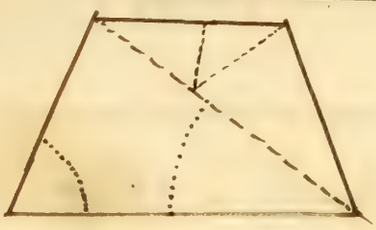
To draw an Oval upon a upon a given ~~Point~~ Length.

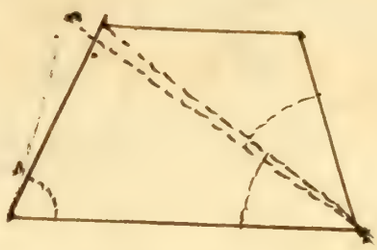
let A B, be the length upon which an Oval is to be formed.



To construct a Rectilinear ~~Figure~~ upon a Right Line given of a determined length similar to a Rectilinear figure given.

let A B be the Line upon which a figure is to be formed like to the figure C D E F.



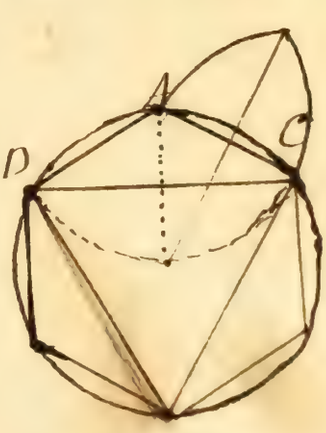


Of the inscription of Figures.

In Geometry a Figure is said to be inscribed in another when all the Angles of the figure inscribed touch either the Angles Sides or Plains of the other figure.

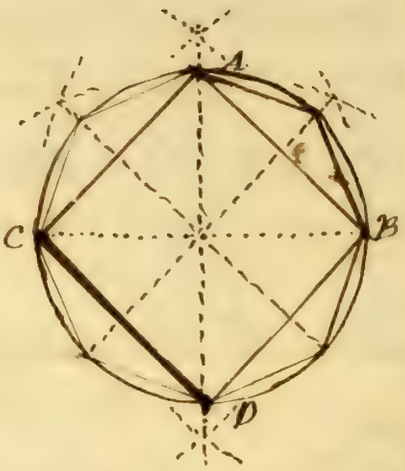
To describe an Equilateral Triangle an Hexagon or a Pendecagon in a given Circle.

let A C D, be the Circle ~~in~~ which an Equilateral Triangle &c. is to be inscribed.

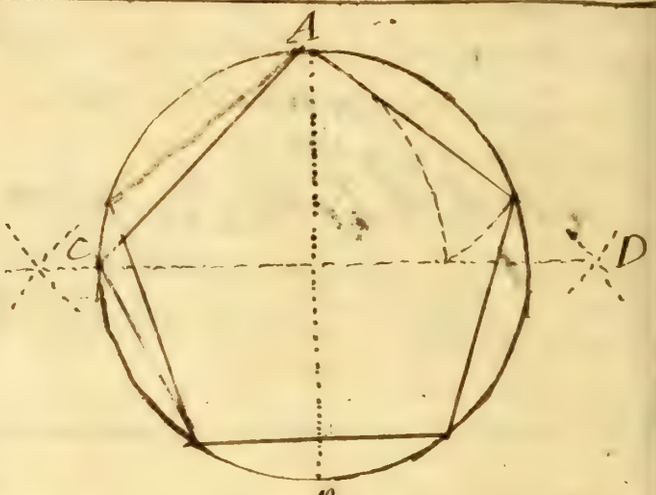


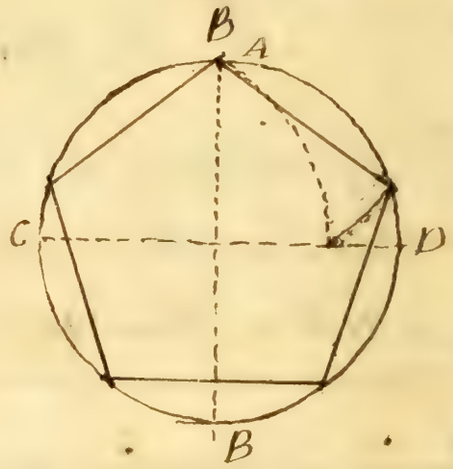
To inscribe a square and and octogon in a given Circle.

let A B C D be the given Circle in which a Square & an Octogon is to be inscribed

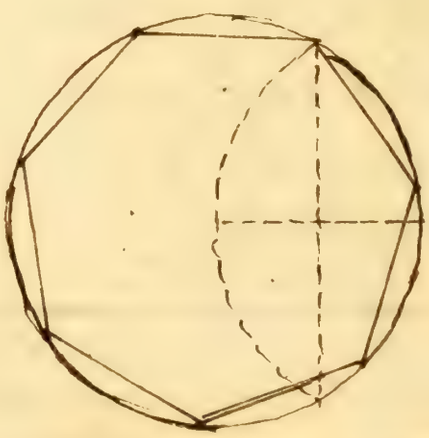


To inscribe a Pentagon & a decagon in Circle given — let A B C D be the given Circle.



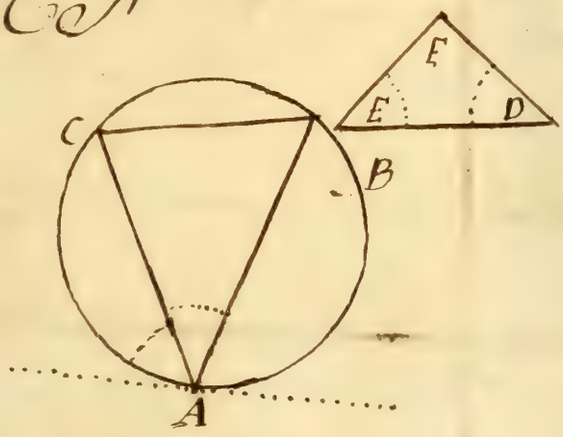


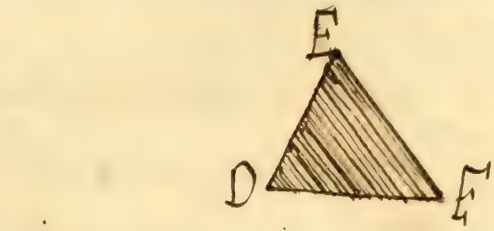
To describe an Heptagon in a given Circle

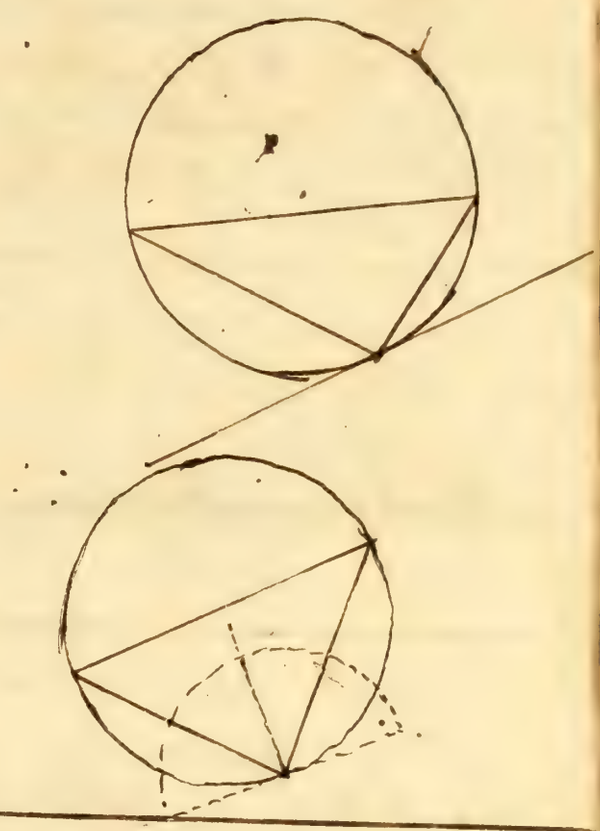


To inscribe a Triangle in a given Circle, Equiangular to a Triangle given.

Let the A B C, be the Circle in which a Triangle is to be inscribed, like the Triangle D E F.



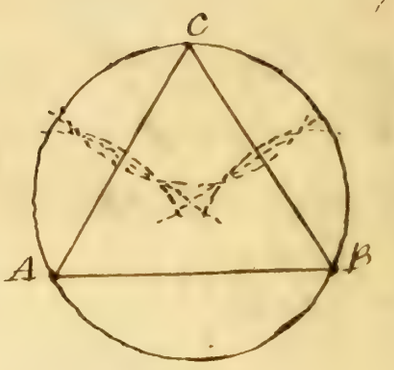




To inscribe a Circle in a given Triangle.

Let A B C, be the Triangle in which a Triangle is to be inscribed.

Of the Circumscription of Figures — A Figure is said to be Circumscribed, when Either the Angles, Sides, or Plains of the Circumscribed Figure touch all the Angles of the Figure that is inscribed.

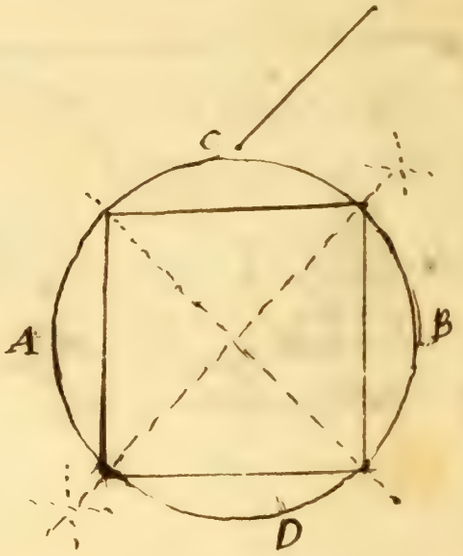


To circumscribe a Circle round a given Triangle.

Let A B C, be the Circle round which a Triangle is to be circumscribed.

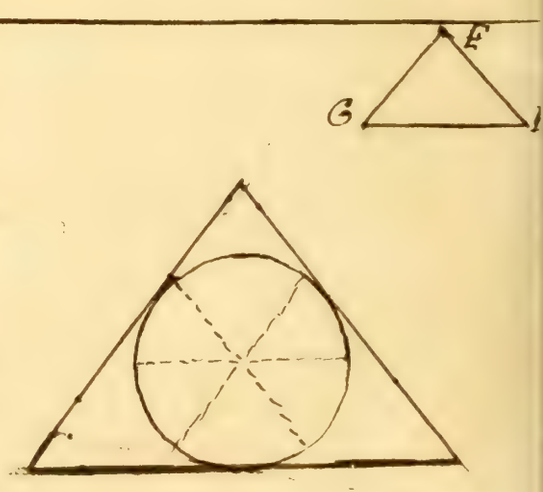
To circumscribe a circle round a given Square.

Let A B C D be the Square round which a Circle is to be circumscribed.



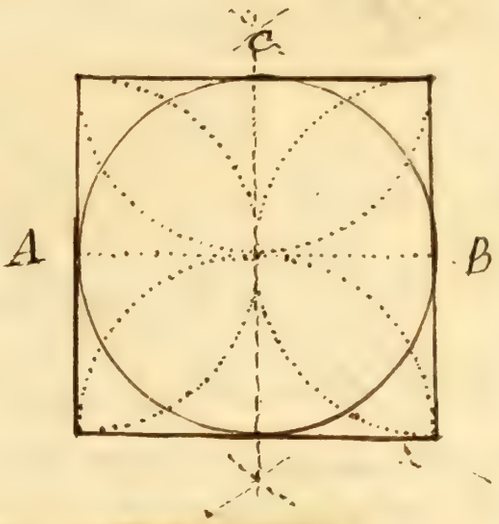
To ~~crib~~ circumscribe a Triangle round a circle, Equiangular to a Triangle given.

Let D E F, be the ~~Triangle~~ Circle round which a Triangle is to be formed like the Triangle G H I



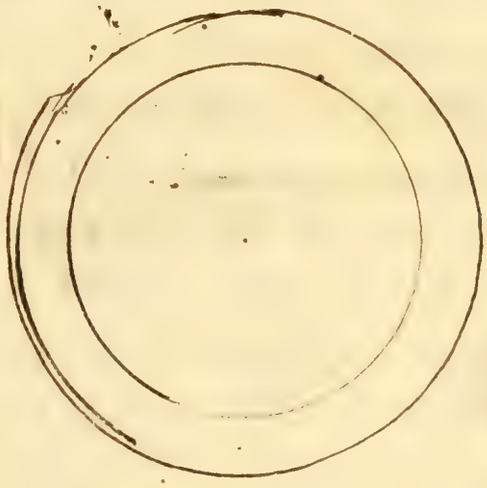
To circumscribe a Square round a Circle.

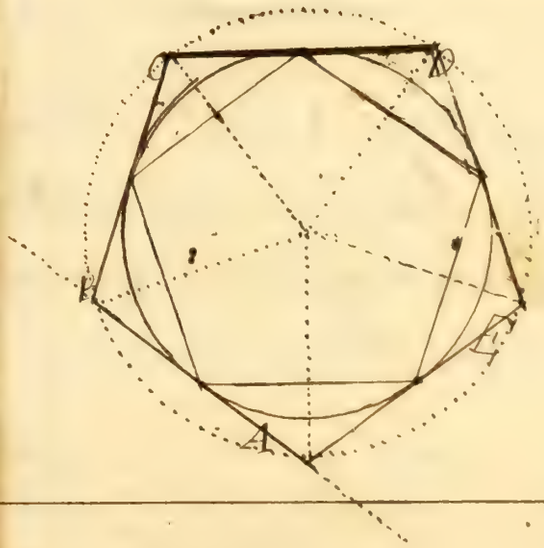
Let ABC. be the Circle round which a Square is to be circumscribed.



To circumscribe a Pentagon round a given Circle.

Let ABCDE be the Circle round which a Pentagon is to be Circumscribed

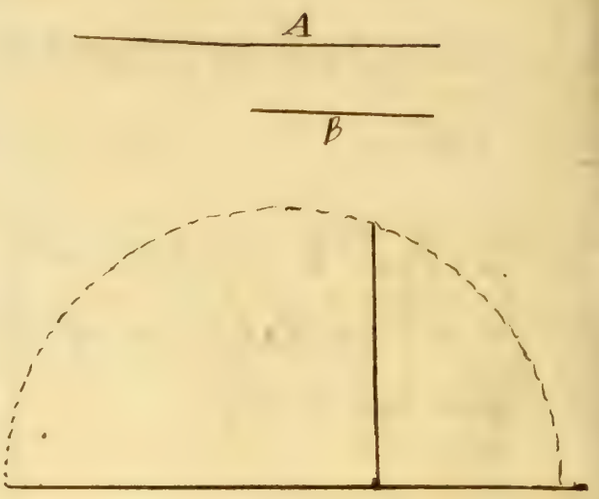




Of Proportional Lines.

To find a mean Proportional between two given Lines.

Let A, B, be the Lines between which a mean Proportional is to be found



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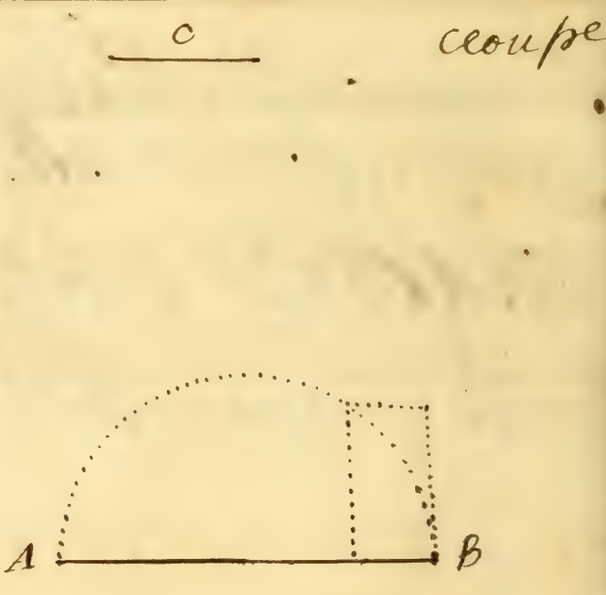
the whole of two Extreams being given, and the mean proportional, to distinguish each Extreme. Let A B, be the extent of the two Extremes (that is, two Lengths joined together without distinction) to which the Line C is a Mean Proportional, and by which the Point where the two Extremes meet is to be found



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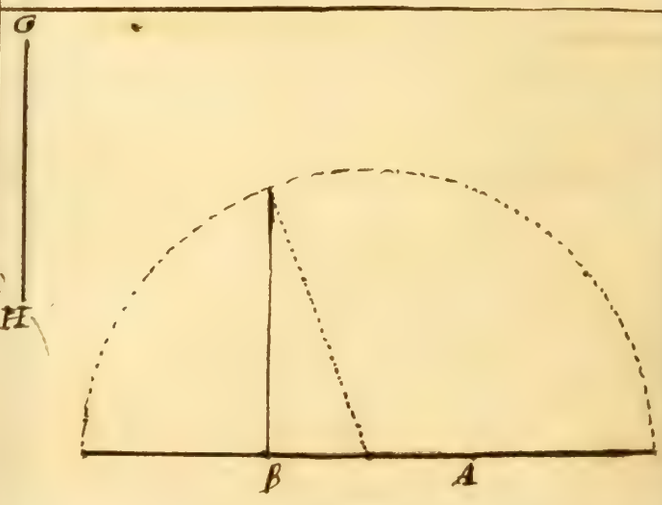
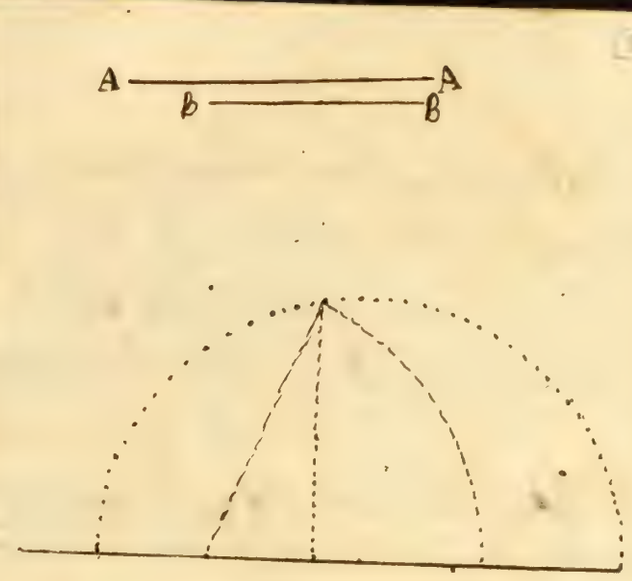
the mean Proportional between two Lines being given, and the the difference of the Extremes, to find the Extremes.

Let G H be the mean Proportional, & A B the difference of the Extremes, whose Length is to be found.



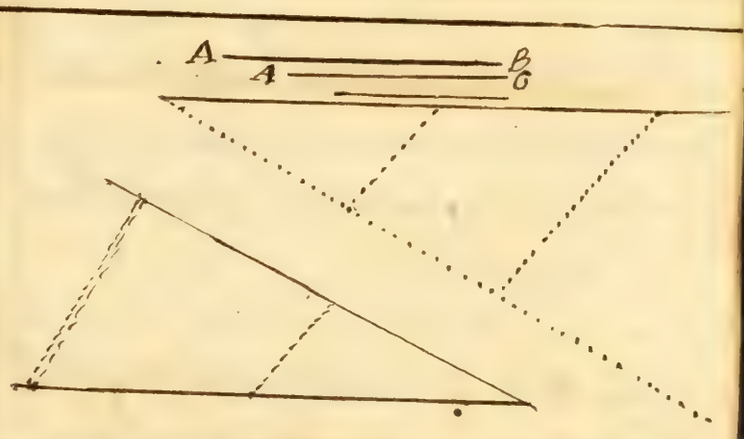
From a Right Line given, to take a part which shall be a mean Proportional between the Remainder & another Right Line given.

Let AA be the Line from whence a Part is to be taken, which shall be a mean Proportional between the Part remaining, & the given Line BB.

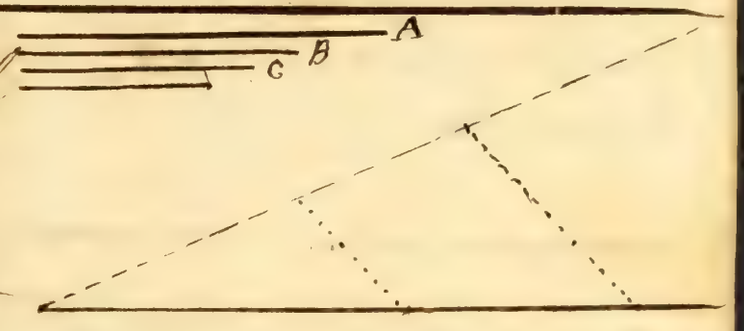


Two Right Lines being given to find a third Proportionable.

A B, A C, are the two given Right Lines to which a third Proportionable is to be found.

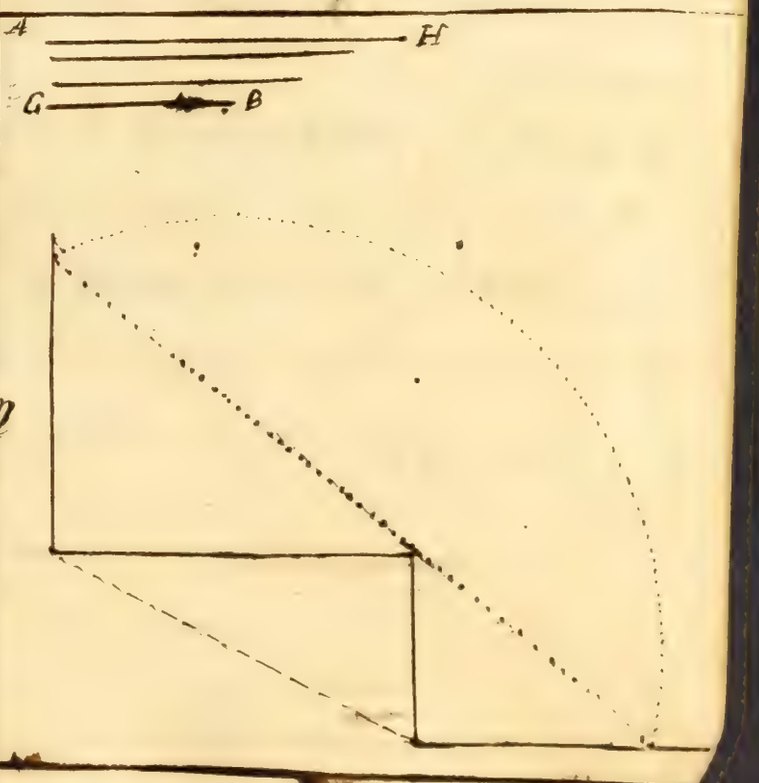


To find a fourth Proportional ~~to~~ - A, B, C, are the three given lines, to which a fourth is to be found, which shall be to the third as the Second is to the first.



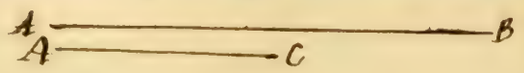
between two Right Lines given to find two mean Proportionals

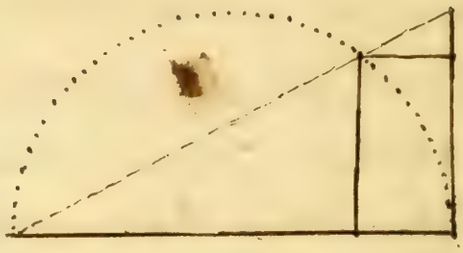
Let A H, & C B, be the given Lines between which two mean Proportionals are to be found.



Two Right Lines being given, to divide each of them into two, in such a manner that the four Segments shall be Proportional.

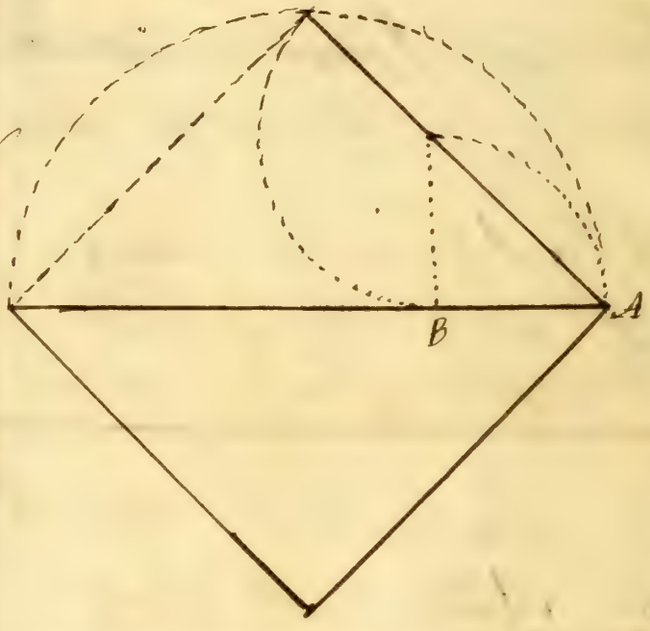
A B, A C, are the Lines proposed to be divided according to the Proposition.





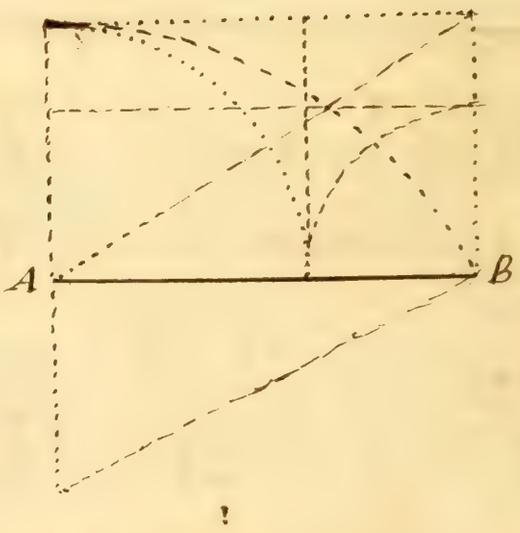
The Excess of the Diagonal of a Square above its Side being given, to find the Length of the said Side.

Let A B be the Excess of the Diagonal of a Square above its Side, whose Length is to be found.



To cut a given Right Line, in Extreme & mean Proportion.

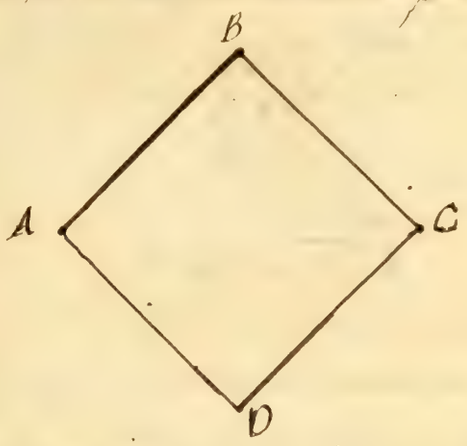
Let A B, be the Line to be so divided, that the Rectangle composed of the Whole & of one of its Parts, shall be equal to the Square formed upon the other Part.



The measuring of Superficies.

Art. 1. To measure a Square. Rule. Multiply the side of the Square into it self and the Product is the Area or superficial content.
Let ABCD, represent a Square, whose side is twelve feet.

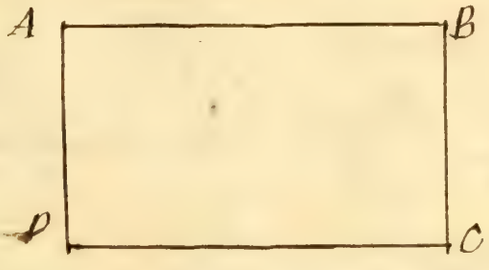
12
12
24
12
144 Area



To measure a

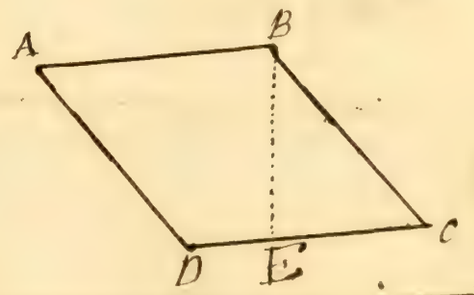
Art 2. Parallelogram. Rule. multiply the Length by the Breadth, & the Product is the Area or superficial content.
let ABCD represent a parallelogram, whose Length is twelve Feet & Breadth 9 Feet.

12
9
108 Area.



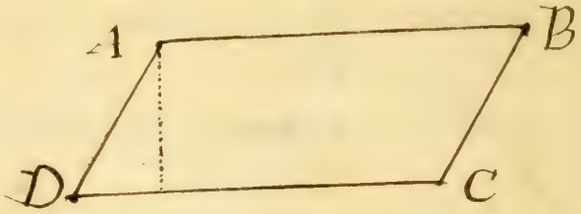
Art. 3. To measure a Rhombus. Rule, multiply the side by the Length of a Perpendicular let fall from one of the Obtuse Angles to the Side opposit such Angle. — Let ABCD represent a Rombus, each of whose Sides is 16 Feet. a Perpendicular let fall from the Obtuse Angle at B, on the Side DC, will enter it in the Point E so will BE be 13 Feet, which is to be multiplyed into 16.

16
13
48
16
208 Area.



Art. 4. To measure a Rhomboides. Rule. multiply one of the longest sides by the Perpendicular let fall from one of the obtuse Angles on one of the longest sides. —— the Rhomboides A B C D; the longest sides A B or C D being 20.9 Feet & the Perpendicular A E, 11.2 Feet.

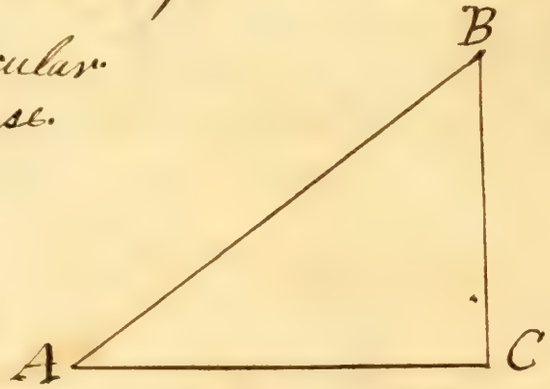
20.9
11.2
418
209
209
234.08 Area



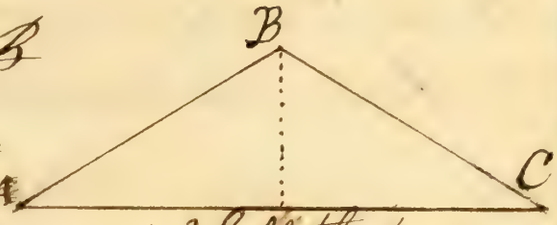
Art. 5. To measure a Triangle. Rule. if it be a Right Angled Triangled Triangle, multiply the Base by half the Perpendicular; or half the Base by the Perpendicular; and the Product is the Area. but if it be an obliquea Angled Triangle (or the obtuse or acute) multiply half the Base by the Length of the Perpendicular let fall on the Base from the Angle opposite to it or the Perpendicular Height by the Base, & the Product is the Area. the Longest side of the Triangle is usually called the Base except in a Right Angled Triangle, where the longest of the two Legs which include the Right Angle is called the Base.

The Right Angled Triangle A B C, Right Angled at C; the Base A C is 21 Feet & the Perpendicular B C 15.5 Feet.

15.5 Perpendicular.
10.5 half the Base.
77.5
0.0.0
155.0
162.75 Area



The ~~obtuse~~ obliqued Angle Triangle ABC being given, Let fall a Perpendicular from the Angle at B on the Base A C, and that Perpendicular is the Height of the Triangle the Base A C being 28.6 and the Perpendicular B D 10. to find the Area.



14.3 Half the Base
10 Height of the Triangle
143.0

Art 6. There is another method of finding the Area of Triangles, (Viz.) the three Sides being given.
Rule. add the three Sides together, then take the half of the Sum, and out of it subtract each side severally: multiply the half of the Sum continually; then extract the Squar Root of this Product, which will be the Area of this Triangle.
In the former obliqe Triangle, the Base A C is given 28.6, the side BC is 16.6, to finde the Area.

28.6
18.32
16.6
63.52
31.76 Half the Sum
3.16
19056
3176
9528
100.36616
13.44
401464
401464
3010848
1003616
134885.9904

31.76
28.6
316

31.76
16.32
13.44

31.76
16.6
15.16

~~2044.6.716~~

1348.859904
15.16
6093594
13488599
67442995
134885599
2044.7160 84

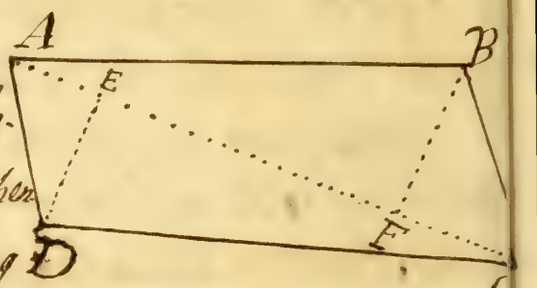
2044.716084 (142.999
1
24) 104
96
282) 844
564
2849) 28471
25641
28589) 283060
257301
285989) 2573984
2573901
2083

thus is 142.999 the Area of the Triangle, which is within .001 Part of what was before found.

Art. 7, To measure a Trapezium.

Rule. Draw a Diagonal from one of the Angles to the opposite Angle, and then will the Trapezium be divided into two Triangles, of which the Diagonal is the common Base; the drawing Perpendiculars from the other opposite Angles to the Diagonal, add those Perpendiculars together, and multiply the half of that Sum into the Diagonal, or the half of the Diagonal into the Sum of the Perpendiculars, and that Product is the Area of the Trapezium.

In the Trapezium ABCD, the Diagonal AC is 498, the Perpendicular DE 10.8, & the Perpendicular BF 18.8: The Sum of the perpendiculars is 29.6, whose half is 14.8, which being multiplyed into 498, gives the Area.

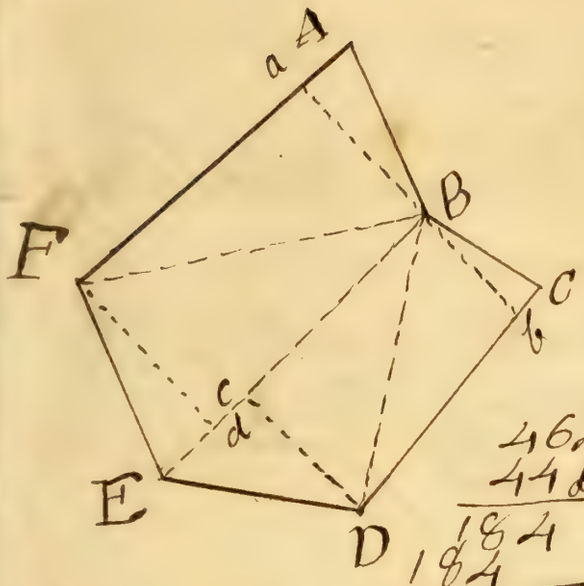


498
14.8
3984
1992
498
7370.4 Area of the Trapezium

Art. 8. To measure any irregular Figure.

Rule — divide the Figure into Triangles, by drawing Diagonals from one Figure into Angle to another; then measure all the Triangles, by either of the Rules allready taught at Art. 6 & 6, and add the several Areas of all the Triangles together, which Sum will be the Area of the given Figure.

Let the irregular Figure to be measured be A B C D E F. —
In the Triangle A F B the Base F A is 100, and the Perpendicular B A 19; In the Triangle F B E the Base B E is 92, and the Perpendicular F 52; In the Triangle E B D, the Base B E is 92 and the Perpendicular D 44; in the Triangle D C B the Base D C is 80, and the Perpendicular B is 38; by which the Area of each may be found, by Art. 6, as follows



50 Half A F
49 Perpendicular B A
450
200
2450 Area of A F B.

46 Half C E
44 Perpendicular D c
184
184
2024 Area of C B D

46 Half B E.
52 Perpendicular F d
92
230
2392 Area of F B E.

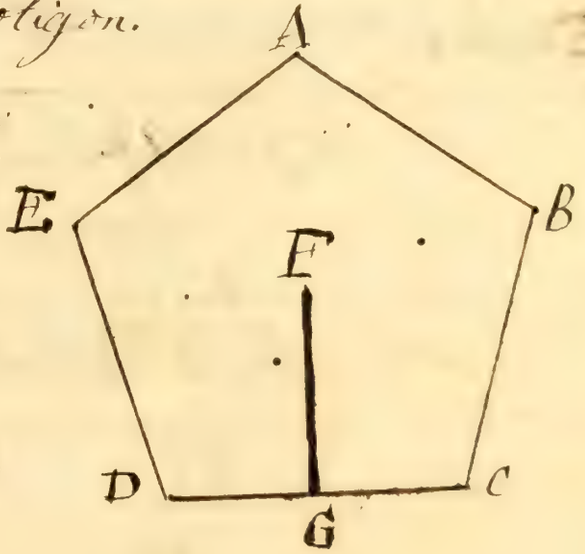
2024 2450
2024
2392
1520
6366 Area of the Figure A B D E F

36 Perpendicular E b.
40 Half D C.
1520 Area of D E C.

Article 9. To measure any Regular Poligon.

Rule. Multiply the Length of one of the Sides, by the Number of Sides; then multyply this Product by the half of Perpendicular let fall from the Center of the Figure to the middle of one of the Sides and the Product is the Area of the Poligon.

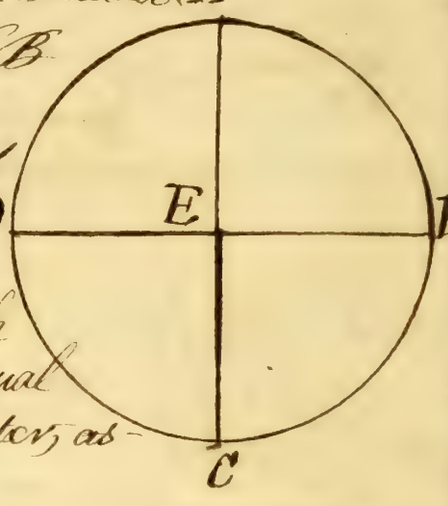
In the Pentagon A B C D E, each Side is 95, and the Perpendicular F G 65.36, To find the Area?



95
5
475 Sum of the Sides.
32.68 Half the Perp. F G.
3800
2850
95
1425
15523.00 Area of the Pentagon.

To Measure a Circle & its Parts.

In the annexed Circle ABCD, the Arch-Line ABCD is is called the Periphery, the Length of which is called the Circumference: Any Line as DB or AC, passing through the Center E, cuts the Circle into two equal Parts, called Semicircles; & such Lines are called Diameters of the Circle: If two Diameters are drawn thro, a Circle at right Angles to each other, then is the Circle divided into four equal Parts called quadrants: Half the Diammeter, as EB is called the Radius or Semidiameter.



Article, 10. The Diameter of a Circle being given, to find the Circumference.

Rule. this may be done by either of the following Propositions; in whole Numbers as 7 is to 22, or in Decimals, as 1 is to 3.14159, so is the Diameter of a Circle to the Circumference.

Exam. A Circle whose Diameter is 17 to find the Circumference.

As 7 is to 22 so is 17.

17
154
22

7)374(53.4 Circumference.
35
24
21
30
28
2

As 1 is to 3.14159 so is 17.

17
2199113
3141 59

53407 03 Circumference.

Article 11. The Circumference of a Circle being given to find the Diameter.

Rule. as 22 is to 7, or as one is .31831, so is the Circumference of a Circle to the Diameter.

Exam. the Circumference of a Circle being 473, to find the Diameter? As 22 is to 7 so is 473

```
      473
        7
  22)3311(150.5
     22
     111
     110
      110
      110
        0
```

As 1 is to .31831 so is 473

```
    31831
      473
   95493
  222817
 127324
150.56063
```

Art. 12 To find the Area of a Circle.

Rule. multiply Half the Diameter by Half the Circumference & the Product is the Area.

If the Diameter is given, find the Circumference by Art. 10; if the Circumference is given, find the Diameter by Article 11.

Exam. A Circle whose Diameter is 17 & Circumference 53.4 to find the Area.

```
  26.7  Half the Circumference
   8.5  Half the Diameter
  1335
 2136
 22695  Area of the given Circle.
```

Art. 13. The Diameter being given, to find the Area of a Circle without finding the Circumference.

Rule. Square the Diameter, then multiply the Square by .7853 and the Product is the Area of the Circle whose Diameter was given.

Exam. The Diameter of a Circle being 17. to find the Area.

17	.78539
17	289
119	706851
17	628312
289	157078
	226.97771 Area of the given Circle.

For greater Expedition, the multiplier may be .7854 which will be sufficiently exact.

Art. 14. The Circumference of a Circle being given, to find the Area without finding the Diameter.

Rule. Square the Circumference, then Multiply that Square by .07958 and the Product is the Area of the Circle.

Exam. The Circumference of a Circle being 53.4 to find the Area.

534	2851.56
53.4	.07958
2136	22812480
1602	14257830
2670	2566404
2851.56	1996092
	226.92711-748 Area of the Circle.

Art. 15. The Dimentions of any part of a Circle being given, to find the Side of a Square equal to the Circle.

Rule. If the Area of the Circle is given, extract the Square Root of the Area, which will be the Side of a Square equal to the Circle: If the Diameter or Circumference be given, find the Area by the Rules in Art. 13 or 14 and extract the Square Root of the Area found, which Root will be the Side of a Square equal to the given Circle. Note this is a general Rule to find the Side of a Square equal to any Superficial Figure, Regular or Irregular: For the Square Root of the Area of ~~a given Circle~~ of any Figure whatever is the Side of a Square equal to the given ~~Circle~~ Figure. But with regard to Circles, if the Diameter is given, multiply it by .886, and the Product will be the Side of a Square equal to the Circle whose Diameter was so given: and if the Circumference is given, multiply it by .282, for the Side of a Square equal to the Circle whose Circumference was so Multiplyed.

Exam. 1.

Let the Diameter of a Circle be 17, to find the Side of a Square equal to the Circle.

.886
17
6202
886
15.062 Side of a Square.

Exam. 2

The Circumference being 53.4, to find the Side of a Square.

53.4
.284
2136
4272
1068
15.1656 Long

53.1
282
1062
4272
1062
15.0546

Art. 16. The Area of a Circle being given to find the Diameter.

Rule. Multiply the given Area by 1.2732, and the Product is the Square of the Diameter; the extracting the Square Root of the Product, gives the Diameter.

Exam. The Area of a Circle being 226.9, to find the Diameter.

226.9
1.2732
6807
15883
1814
2269
289.04137

289.04137 (16.99 the Diameter.
1
26) 189
156
329) 3304
2961
3389) 33437
30501
1936 Remainder.

Art. 17. The Area of a Circle being given to find the Circumference.

Rule. Multiply the given Area by 12.566, and extract the Square Root of the Product, which Root will be the Circumference of the Circle whose Area was so multiplied.

Exam. The Area of a Circle being 226.9; to find the Circumference?

12.566
226.9
113094
75396
25132
25132
2851.2254

2851.22 54 (53.39
25
103) 351
309
1063) 4229
3189
10669) 10334 54
96021
7333 Remainder.

Art. 18. The Side of a Square being given, to find the Diameter of a Circle equal to the Square whose Side is given.

Rule. Multiply the given Side by 1.128, and the Product will be the Diameter of a Circle whose Area is equal to the Area of the given Square.

Exam. The Side of a Square being 15.04, to find the Diameter of a Circle equal to that Square.

16.04
1.128
12832
3008
1204
1604
16.96512. Answer.

Art. 19 The Side of a Square being given to find the Circumference of a Circle equal to the given Square.

Rule. Multiply the given Side by 3.545, and the Product will be the Circumference of a Circle equal to the Square.

Exam. The Side of a Square being 16.04, to find the Circumference of a Circle equal to that Square?

16.04
3.545
7920
6416
7920
1412
56.86180 Answer.

Art. 20. To find the Area of a Circle, Semicircle, the Diameter being given.

Rule. Find the Area of the Circle, by Art. 13 and take 4th Half of it.

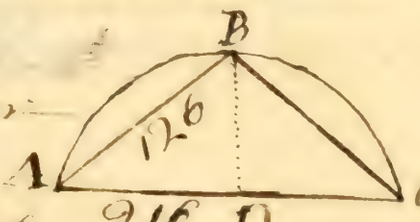
Art. 21. A Sector or Segment of a Circle being given, to find the Length of the Arch Line.

Rule. Divide the Segment in to two equal Parts; the Measure the Chord of the Half Arch, from the Double of which subtract the Chord of the whole Segment; and one third of that Difference, being added to the Double of the Chord of the Half Arch. is the Length of the Arch Line.

Exam. in the Segment ABCD, the whole Chord ADC. is 216, and the Chord AB or BC 126, to find the Arch-line ABC?

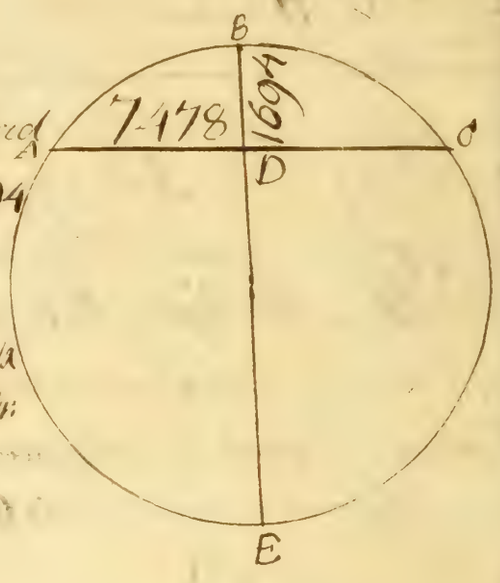
126 Chord AB or BC
2
252
216
36 Difference

252/12 Double of AB.
264



Art. 22. The Chord and versed Sign of a Segment being given, to find the Diameter of the Circle.

Rule. Multiply half the Chord by itself, and divide the Product by the versed Sign; then add the Quotient to the versed Sine, and the Sum is the Diameter of a Circle.



Exam. In the Segment ABCD, the Chord AC is 7178, and the versed Line BD 1694 to find the Diameter.

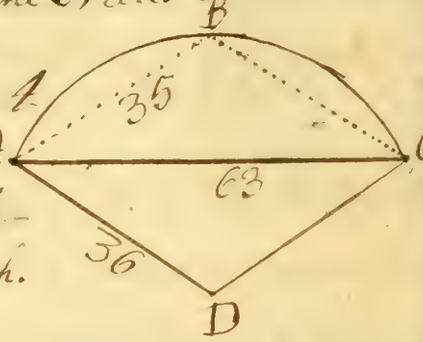
3739 half the
3739 Chord AD.
33651
11217
26173
11217
13940121

1694)13940121(8252 DE.
13552
38881
33888
59932
58470
14621
13552
1069

1694 BD added
9944 Diameter.

Art. 23. To Measure a Sector.

Rule. Find the Length of half the Arch by Art. 21; then Multiply this by the Radius or Semidiameter, and the Product is the Area.

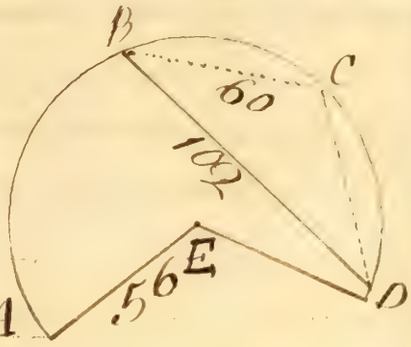


Exam. 1. In the Sector ABCD, given the Radius AD or DC 36 Feet, the Chord AC 63 Feet, and AB the Chord AB or BC 35 Feet, to find the Area of the Sector?

35 Chord AB
2
70
63 Subtract.
317
2.333
70 added.
72.333 Length of the Arch ABC by Art. 21.

36. 166. Half the Arch.
36. Radius.
216996
108498
1301.976 Area of the Sector.

Exam. 2. In the Sector ABCD, greater than a Circle, given the Radius AE or ED 56, the Chord BD of Half the Arch ABD 102, and the Chord BC or Half the Arch BCD 60, to find the Area of the Sector?



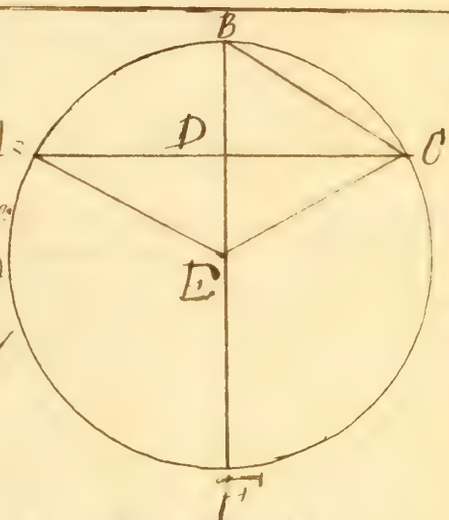
60 BC.
2
120
102 Subtract.
318
6
120 add.
126 Length of the Arch ABC by Art. 21.

126 Half the Arch.
56 Radius.
756
630
7056 Area of the Sector.

=of a Circle

Art. 21. To find the Area of a Segment

Exam. 1. To find the Area of the Segment ABC, whose Chord AC is 96, the Chord of Half the Arch BC 52, and the versed Sine BD 29.24?



Rule. By Art. 21, find the Length of the Arch Line ABC, and by Art. 22, the Diameter BF; then Multiply Half the Chord of the Arch ABC by Half the Diameter; and the Product is the Area of the Sector ABCE, then find the Area of the Triangle AEC, whose Base AC is 96, and Perpendicular Height DE 17, found by substracting the versed Sine BD from Half the Diameter; the Area of the Triangle AEC, being substracted from the Area of the Sector ABCE, leaves the Area of the Segment ABC.

~~50 BC~~
~~2~~
~~104~~
~~96 Subtract AC.~~
~~318~~
~~6~~
~~104~~
~~110 Arch Line ABC~~

~~43 Half AC.~~
43
129
172
29.24) 1549.00 (63.25
1754 1
9460
6772
6500
5948
10420
6772

6451 15490
16120
460

52 BC
2
104
96 AC Subtract.
3) 10
6
10 1 add.
11 C. Arch-Line ABC.

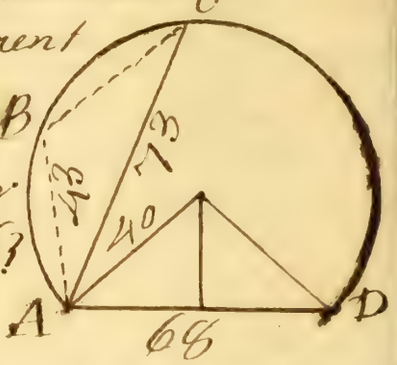
16.237 Radius.
55 Half the Arch.
231185
231185
2543.035 Area of the Sector.

13 Half the Base AS.
17
301
13
731 Area of the Triangle.

43 Half AD C.
43
129
172
29.24) 1849.00 (63.235 DE
1754 4 29.24 BD add
9460 92.475 Diam. BS
8772
6880
5844
10320
9772
15480
14620
860

2643.
131
1612 Area of the Segment

Example. 2. In the Segment ABCD, greater than a Semicircle, given the Chord of the whole Segment AD 68, the Chord of the Arch AC 73, the Chord AB or BC of one fourth of the Arch ABCD 43, and the Radius AE or ED 40, to find the Area of the Segment ABCD.



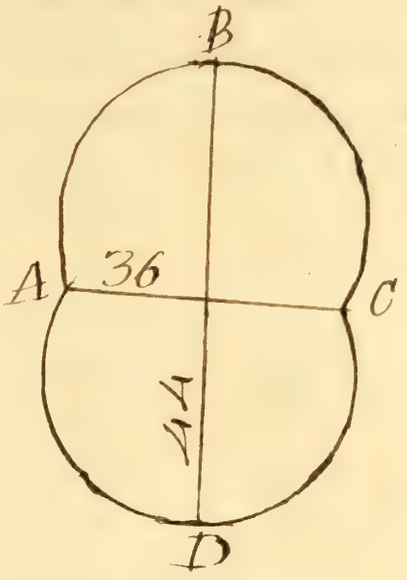
Rule. First find the Area of the Sector ABED, by Art. 21, at the Second example; then find the Area of the Triangle AED, by Art. 15; and adding the Area of the Triangle to the Area of the Sector, that Sum is the Area of the Segment.

43 Chord AB.
2
86
13 Chord AE Subtract.
3) 13
4.333
2 Double of AB add.
90.333 Arch-Line AB
40
3613.320 Area of the Sector.

34 Half the Base AD.
21 Perpendicular EG.
34
68
714 Area of the Triangle AED.
3613.32 Area of the Sector add.
4327.32 Area of the Segment.

Art. 25 To find the Area of an Ellipsis.

Rule. Multiply the Two Diameters of the Ellipsis together; then multiplying that Product by .78539 or .7854, this last Product is the Area of the Ellipsis

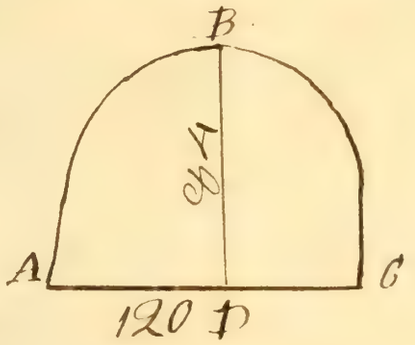


44
36
264
132
1584
7854
6336
7920
12672
110484
1244.0736 Area of the Ellipsis.

Art. 26. To Measure a Parabola.

Rule. Multiply the Base by the Height, and the Product by 2, then divide this last by 3, and the Quotient is the Area. —

Example. the Base AC is 120,
and the Height BD 84,
to find the Area.



120
84
480
960
10080
2
3)20160(6720 Area.
18
21
21
6
0

The Measuring of Solids.

The Solid Foot is composed of 1728 Inches: For a Solid that is one Foot, or 12 Inches, every way, the Solid Content is 1728 Inches, as appears by the following Article.

Art. 27. To Measure a Cube.

Rule. Multiply the Side by itself, and that Product by the same Side, and this Product is the Solid Content of the Cube.

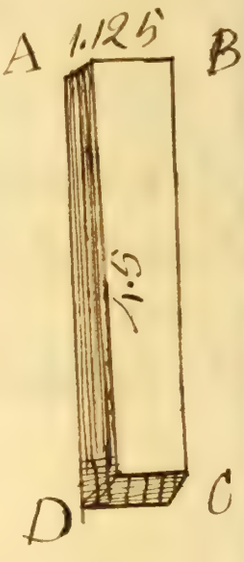
Exam. The Side of a Cube being 15 Inches or 1 Foot and 3 Inches, to find the Content

1.25		15	
1.25		15	
625		75	
250		15	
125		225	
1.5625		15	
1.25		1125	
19125		225	
31250		3375	(1.953125
15625	1728	1729	
1.953125		16470	
		15552	
		9180	
		6910	
		5400	
		5184	
		2160	
		1729	
		4320	
		3456	
		6910	
		6910	
		0	

Art. 29. To Measure a Parallelopipedon.

Rule. Find the Area of the Base, then Multiply that by the Length, it gives the Solid Content.

Exam. 1. The Solid AB is 1.125, and the Length CD 1.5, to find the Solid Content?



1.125
1.125
5625
2925
1125
1125
1265625
1.5
6328125
5062500
5.6953125 Solid Content.

Example 2. A Vessel being 2.5 Feet each side within, and 2.5 Feet deep, to find the Content?

2.5
2.5
125
50
6.25
2.5
15.625 Content.

Example 2.3. A Piece of Timber being 1 Foot and 3 Inches or 15 Inches Broad, 9 Inches thick and 8 Feet and 6 Inches, or 102 Inches, Long, to find the Content.

1.25 1.25
.75 .75
625 625
875 875
9375 .9375
55 5.1
46875 46875
75000
7.968750 Content

15 Inches.
9 Inches.
135
102
270
1350
13770 (7.968750
12096
16740
15552

11880
10368
15120
13824
12960
12096
8640
8640
0

Art. 29. To measure a Cylinder.

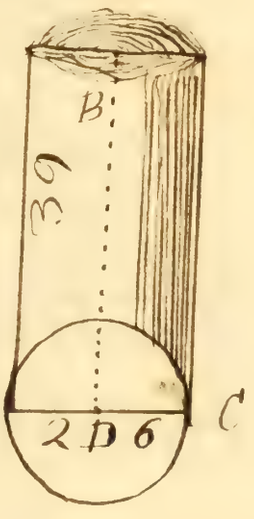
Definition. A Cylinder is a round Body, whose Bases are Circles, like a round Column, or a Rolling Stone of a Jorden.

Rule. The Diameter of the Base being given, find the Area, by Art. 13. Then Multiplying the Area of the Base by the Length, that Product is the Content of the Cylinder.

Exam. The Diameter of the Base AC being 2 Feet and 6 Inches, and the Length BD 3 Feet and 9 Inches, to find the Content? The Inches being changed into the Decimal Fractions of a Foot, as in the Last Example.

2.5 Feet, Diameter of the Base.
2.5
125
50
6.25

7854
6.25
39270
15708
47124
49.0 8750 Area of the Base.
3.75 Length.
245 4375
343 6125
147 2625
14.7 1093 7500 Content.



Art. 30. To Measure a Cone.

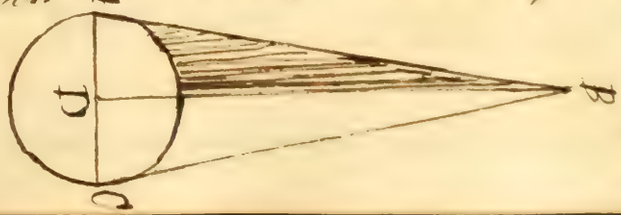
Rule. Having the Diameter of the Base, find the Area by Art. 13; then multiplying the Area of the Base by one third of the Perpendicular Height, that Product is the Content of the Cone.

20
20
400

3141.6
20
62832.0 Content.

7854
400
3141.6000

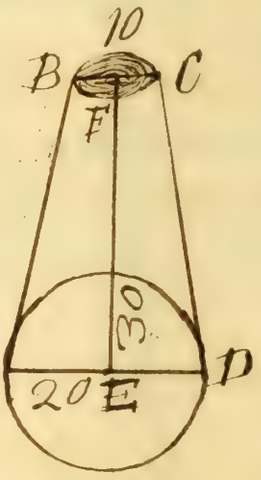
Exam. The Diameter of a Cone 20 and the Height 30 to find the Content.



Art. 31. To measure the Frustum of a Cone.

Rule. Multiply the Diameter of the two Bases together and to this Product add on third of the Square of the difference of the Diameters; then multiply by the Sum by .7854, it will be a mean Area between the two Bases, which being multiplyed by the Length of the Frustum, gives the Solid Content.

Example. The former Cone being cut off in the Middle, the greater Diameter AD is 20, and the lesser Diameter BC = 10, and the Height EF 30, to find the Content of the Frustum?

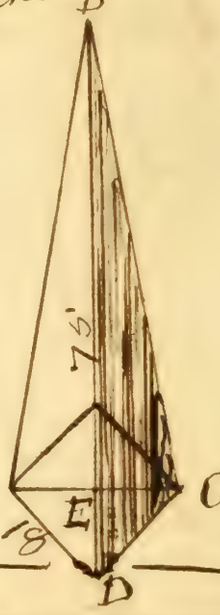


20
10
200
33.333
233.333
.7854
933332
1166665
1866664
1633331
183.2597342 mean Area.
30
5497.7921460 Content of the Frustum.

20
10
10
10
3)100. Square of the difference.
33.333 1/3 of the Square.

Art. 32. To measure a Piramid.

Rule. Find the Area of the Base wether a Triangle, Square, Heptagon, or the like, by the Rules laid down in Superficiall Measure; then multiply the Area of the Base by one third of the Height, that Product is the Solid Content, of the Piramid.



18
18
144
18
324 Area of the Base.
25 1/3 of the Height.
1620
648
8100 Content.

Exam. 1. A quadrangular Pyramid, the Height BE being 75, and each Side of the Base 18, to find the Content?

Exem. 2. A Triangular Pyramid, the Height BE being 96, and each side of the Base 25; and the Base of this Figure being a Triangle, & the Perpendicular Height DE be 21.64; to find the Content?

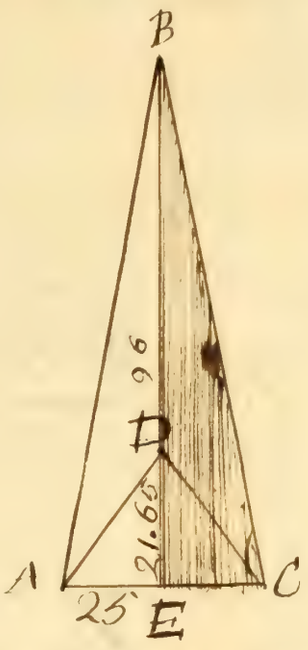
21.65 Perpendicular DE.
12.5

10825
4330
2165

270.625
32 1/3 of the Height.

541250
81187.5

8660.000 Content.



Art. 33. To measure the Frustum of a Pyramid.

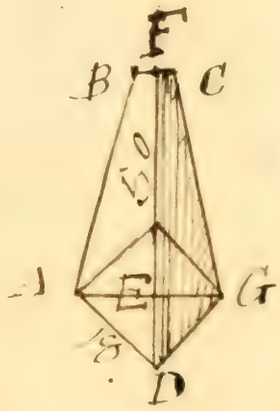
Rule. Multiply the Side of the greater Base by the Side of the lesser, and to the Product add one third of the Square of the difference of the Sides: If it is a quadrangular Base, this is the mean Area between the Bases; but if the Base is any other Regular Figure, take the multiplier in the Table Art. 9, by which multiply the Sum the Product is the mean Area between the Bases; Lastly, multiply this by the Height, it gives the Content of the Frustum.

Exam. 1. The Side of the greater Base AD 18, as before, the of the lesser BC, 6, and the Height EF 50, to find the Content?

18
6
108
48
156

18
6
12
12
24
12
3|144
48 1/3 of the Square.

156
50
7800 Content.

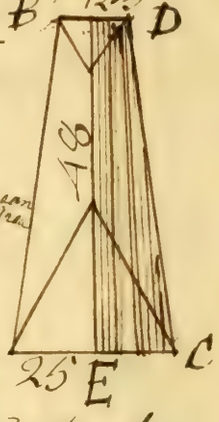


Example. 2. The side of the greater Base AC 25, as before, the side of the lesser Base BD 12.5, and the Height EF 48, to find the Content.

12.5
25
625
250
3125
5234
364

25
12.5
12.5 Difference between the sides
12.5
625
250
125
3)156.25 Square of the Difference.
52.083⅓ of the Square.

364.58
433
109374
109374
145832
157.66 | 314 Mean Breadth
48 Height.
126290
63145
7577.40 Content.



Art. 34. To measure a Globe.

Rule. Cube the Diameter, then multiply that Cube by .5236, and the Product is the solid Content of the Globe.

Exam. The Diameter of a Globe is 3.2 to find the Content.

3.2
32
64
96
1024
32
2048
3072
32768

32.768
5236
196608
98304
65536
163840
17.157324 Content.

If the Circumference of the Globe is given, Cube the Circumference, and multiply the Cube by .01687, for the Content.

Art. 35. To measure the Surface of a Globe

Rule. Multiply the Circumference and Diameter together, and the Product is the Superficial Content, or Area, of the Surface of the Globe.

Exam. The Diameter of a Globe being 3.2 to its Area?

3.1416		10.053
3.2		3.2
62832		20106
94248	(by Art. 10,	30159
10.053312	Circumference.	32.1696 Area of the Surface.

Art. 36. To measure the Solidity of a Frustum or Segment of a Globe.

Rule. To three times the Square of the Semidiameter of the Base add the Square of the Height; then multiply that Sum by the Height, and the Product by .5236, it gives the Solid Content.

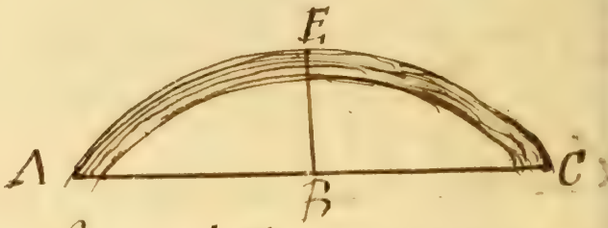
Exam. The Height B D being 12 Inches, and the Diameter of the Base A C 26 Inches, to find the Content?

13	12 Height.		7812
13	12		.5236
39	144		46872
13			23436
169			15624
3			39060
507			4090.3632 Solid Content.
144			
651			
12			
7812			

Art. 37. To measure the Surface of a Frustum or Segment of a Globe.

Rule. Find the Diameter of the Globe by Art. 22, or the Superficies of the whole Globe by Art. 35; then say, as the Diameter of the Globe, is to the Height of the Frustum, so is the Superficies of the Globe to the Superficies of the Curve Part of the Frustum; then find the Area of the Base, by Art. 13, and add these two together, which will be the whole Surface of the Frustum.

Exam. The Diameter AC being 12, and the Height BE 13, to find the Superficies?



3.1416
112
62832
31416
31416
351.9296 Circumference.
112
703716
351929
351929
39410.6752 Area of the Surface of the Globe.

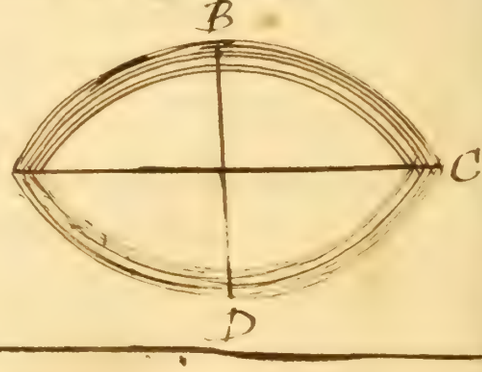
As 112 is to 13 so is 39410.6752
13
118224
39410.6752
(112) 512304.4576
448
643
560
830
784.
464
448
16

5184 Square of the Diameter of the Base.
7854
20736
25920
11472
36288
10179.5136 Area of the Base of the Frustum.
4574 Area of the Curve Surface added.
6645.5136 Area of the whole Segment.

Prob. To measure a Spheroid.

Rule. Multiply the Square of the Diameter of the greatest Circle, that is, the Diameter of the middle, by the Length; then multiply that Product by .5236, this Product is the Solid Content.

Exam. The Diameter AC being 24, and the length BD 30, to find the Content?



24
24
96
50
576
30
17280
5236
103680
51840
34560
86400
17280) 90477.5680 Solid Content.

Art. 39. To find the Side of a Cube equal to any solid Body.

Rule. The solid Content of any Body being given, extract the Cube Root of the given Solidity, which will be a Side of a Cube equal to the Body whose Solid Content was so given.

Exam. 1. Find the Side of a Cube whose Content is equal to a Globe whose Content is 16974.593.

16974.593 (25.7
8
12 | 89
1 5625
1675 | 13495
16974593

Side of the Cube
25.7
2
3
25.7
12 | 1799
1265
514
660449
252
4623143
3302245
1320966
16974593

16974.593 (25
8
4974
1200
60
1260
25
300
1200
1525
5
7625
13495 93
16750 0

Exam. 2. Find the Side of a Cube equal to a Spheroid whose Content is 9047.808.

9047.808 (20.8 Side 20. of the Cube.
8
1200) 1047.808
120000 1047.808
960000
87808
512
20
400
800
12000
998912
48896 Remainder.

Art. 40. To measure the Solidity of any irregular Body, whose Dimensions cannot be taken.

Rule. Fill any regular Vessel, either Square or round, and into it put the Body to be measured; and pour Water into the Vessel so as to cover the Body, and measure the dry Part from the top of the Vessel to the Surface of the Water; then take out the Body, and measure again from the top of the Vessel to the Water, and subtract the first-

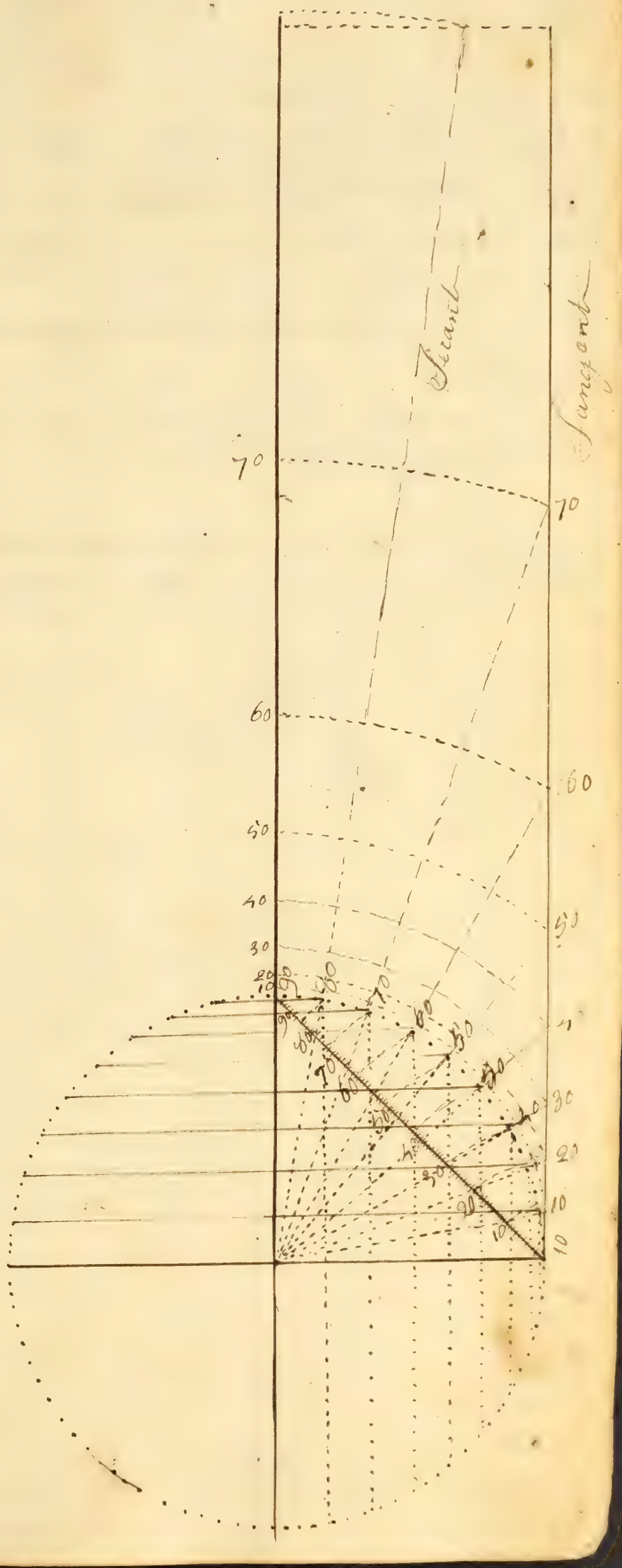
Measure
Number from the Second, which is the Fall of the Water: Then if the Vessel is Square, measure one Side and multiply it by itself, and that Product by the Fall of the Water, which last Product is the Content of the Body: But, if it is a long Square, as a Cistern, Multiply the Length by the Breadth, and that Product by the Fall of the Water: Or Lastly if it is a round Vessel, Square the Diameter and Multiply the Square by .7854, and that Product by the Fall of the Water, which gives the Solid Content of the Body.

Exam. 1. A Body being put in a Vessel 18 Inches Square, the Water sunk 6 Inches. What was the Content of the Body?

1.5
1.5
75
15 (of 6 Inches.
2.25 Decimal
5
1.125 Content

Exam. 2. A Body being put in a Cistern 2 Feet wide, and 4 Inches long the Water sunk 9 Inches, what was the Content of the Body?

½
2
6 (of 9 Inches.
.75 Decimal
10
56
6.00 Content.


Tang
Sangent
70
60
50
40
30
20
10
90
80
70
60
50
40
30
20
10

Problems previously necessary to plain Trigonometry

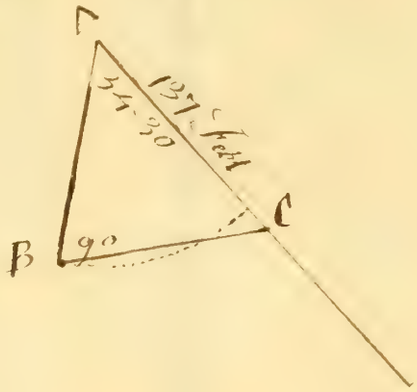
Problem 1. To make a Right Angled Triangle, the Hypothenuse and one Angle being given.

N B The three Angles of any plain Triangle are equal to 180 Degrees. A Right Angle is always 90 Degrees, when you have an Angle given besides the Right, subtracting that from 90 gives you the remaining Angle,

An Angle may be denoted by this Mark ∠ a Triangle by this △ a Right Angle by this ∟

Example. The Hypothenuse AC 137 Feet } with these to make a Right Angled Triangle
The Angle ABC 34° 30 Mins. }

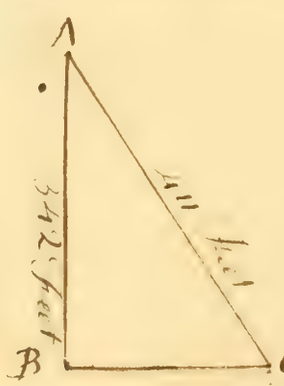
Line. Make a ∠ = 34° 30 draw the Line AC = 137, from C let fall a Perpendicular, to cut AB and it is done.



Problem 2. To make a Right Angled Triangle, the Hypothenuse and one Leg being given;

Example. Hypothenuse AC 411 Feet, Leg AB 342 Feet.

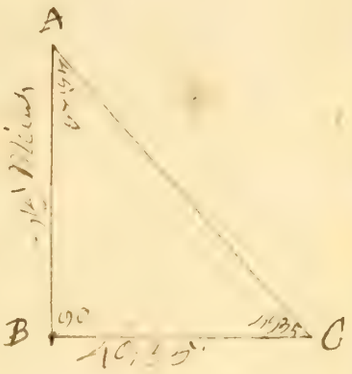
Line. make AB equal to 342, erect the Perpendicular BC with the Extent of 411 in your Compasses taken from your Scale of equal Parts, and one Foot in A cut the Perpendicular in C, draw a Right Line from A to C.



Problem. 3. To make a Right Angle Triangle, one Leg and one L being given,

Exam. The Leg AB 415 and angle BAC 40° 25 M given;

Rule. Make AB equal to 415 M. at A make an L = 40° 25, erect a Perpendicular BC, and continue your Line AC till it cut it.



Problem. 4. To make a L^d Δ the Legs being given.

Exam. Leg AB = 404 — Leg BC = 328.

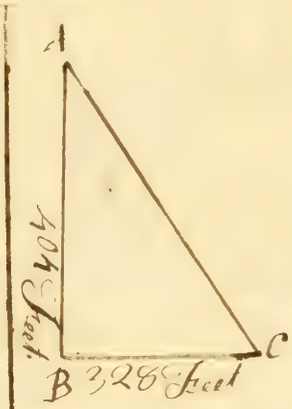
Rule. Make AB = 404. — at B erect the Perpendicular BC 328. Join B and C — and it is done.

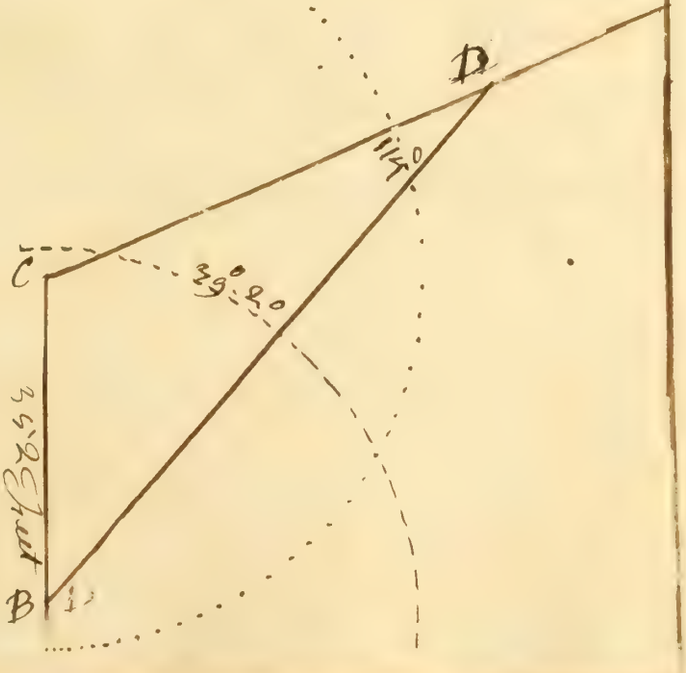
Problem. 5. To make an Oblique L^d Δ 2 Angles and one Side opposite being given.

Example. the Angle BCD = 114°. BDC = 26° 40

Side BC = 352.

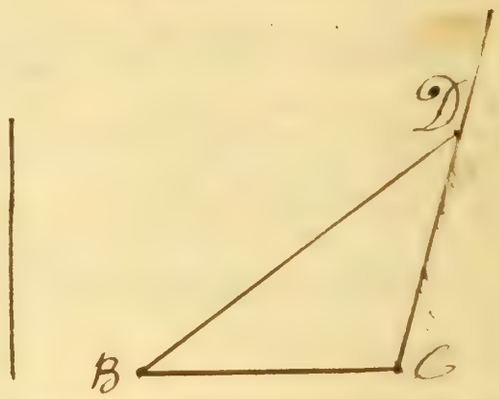
Rule. make BC = 352; at C make an Angle 114, 00. Then add 114 & 26, 40 together, and subtract the Sum 180 the Remainder is 39° 20 = the other L which makes at B, draw the Lines BD and CD till they meet.





Problem 6. To make an Oblique $\angle^d$ Δ 2 Sides and one $\angle^r$ opposit being given. ——— Exm. The Side BC = 274, BD 426 The $\angle$ BCD = 106^d, 30 M.

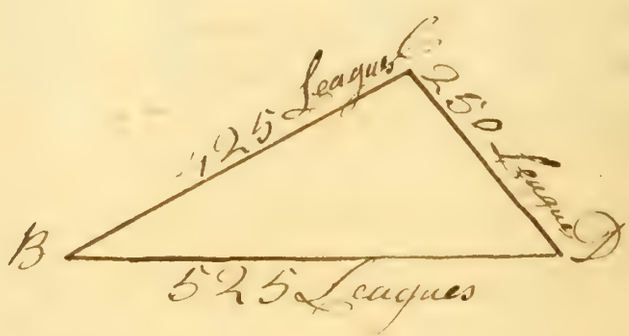
Rule. make BC = 274 at C make an $\angle$ = 106^d, 30 with 426, cut the Line CD in D draw BD.



Problem. 7. Make a Δ 3 Sides being given.

Exm. { The Side BD 525
" BC 425
" CD 250 }

Rule. Make BD = 525 Leagues, then with 425 Yards one Foot in B. Draw the Arch C, with 250 Yards one Foot in D cut the Arch in C from C draw the Lines to B and D.



Plain Trigonometry

Trigonometry, or the Measuring of Triangles, is of two Kinds, The Measuring of Right-Lined Trianangles, otherwise called plain Trigonometry, is called plain Trigonometry: The measuring of curve-lined Triangles, commonly called Spherical Triangles, is called Spherical Trigonometry.

Definitions

A plain Triangle is a Figure containd between three right lines, which at their Meeting make the Angles.

If one of the three Angles of a Triangle be a right Angle, the Triangle is called a right Angled Triangle.

If neither of the Angles of a Triangle is a right Angle, the Triangle is called an Obligue Angled Triangle.

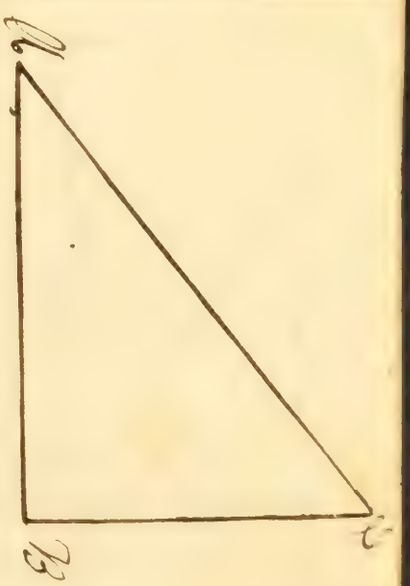
If, in an Obligue Angled Triangle, one of the Angles is Obtuse, that is, greater than a right Angle, it is called an Obtuse-Angled Triangle.

If all the three Angles are acute, that is less than right Angles, then is the Triangle called an acute-Angled Triangle.

If all the three Sides of a Triangle are equal, it is called an Isosceles

If the three Sides are all unequall, it is called Scalenum.

In a right-angled Triangle, as A B C, the longest Side, A B, is called the Hypothenuse, and the other two Sides the Legs, of which, that on which the Triangle seems to stand, as B C, is called the Base, and the other side A C the Perpendicular. In an Obligue Angled Triangle, the longest Side is usually called the Base.

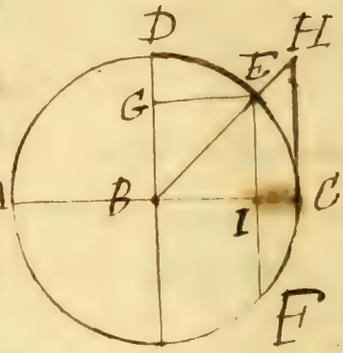


Angles are Measured by the Arch of a Circle.

the Periphery or Circumference of every Circle, whether great or small, is divided into 360 Degrees, each Degree into 60 Minutes, every Minute into 60 Seconds,

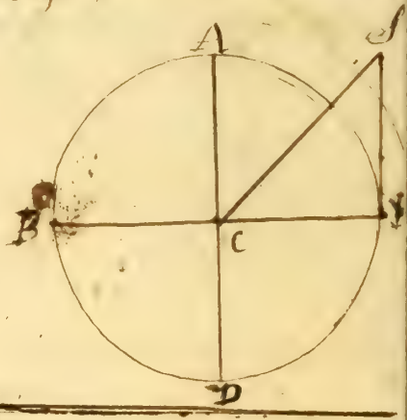
and soon to find Sines, Tanths, &c.

Any Portion of the Periphery of a Circle as E F is called an Arch; and a Line drawn from the ends of an Arch, as E I. F, is called the Chord of the Arch, half a Chord or one of any Arch, as E I, is called the Sine of the Arch E C; so also E G is the Sine of the Arch E D. A Line drawn perpendicular to the Diameter of a Circle, so as to touch the Circle, and not cut it, is called a Tangent, as C H, which is the Tangent of the Arch E C, because the Line B H, drawn from the Center B through E, called the Secant, meets it in the Point H. any Radius as B D, is the Sine of 90°, equally the whole Sine.



Axiom the 1.

If the Perpendicular, of a right-angled Triangle, be made the Radius of a Circle, the Base will be a Tangent of its oppo-sit Angle, and the Hypothenuse the Secant, of the same as in the last Figure.

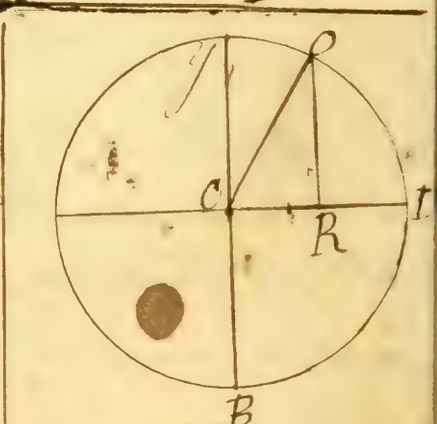


Axiom. 2.

If the Base of a Triangle be made the Radius of a Circle the Perpendicular will become a Tangent of its opposit Angle, and the Hypothenuse is Secant of the same, when and

Corll. 2

When an Δ is applied to the opposit ∠ & the Hypothenuse a Secant in manner of the Figure Annexed, its longest side will be the Radius of the Circle C.O & its Base OR which is the Sine of its opposit Angle (viz.) ∠ C B the Perpendicular will be the Sine of the Angle opposit to it: viz, the Perpendicular R, S. O which is the Sines

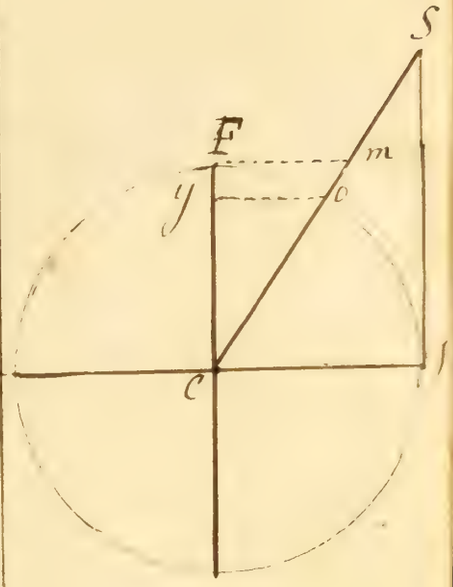


of the Angles of C
C R which is the
opposit to its Perpe
ndicular.

Plain rectangular Trigonometry.

Axiom. 3.

If the Hypothenuse be made the Radius of a Circle, the Base will become the Line of the ∠ at the Perpendicular, and the Perpendicular the Line of the ∠ at the Base.



Article 3.

When a ∠ applyed in the manner of the Figure annexed is considered as conteined with relation to such parts of the Circle as are not immediately comprehended by it or adjoyned to any of its parts, hee will arise the following Terms.—

The Complement of an Arch, which is what it wants of a Quadrant, so C F is the Complement of the Arch F O, a Cosine which is the Sine of the Complement of any arch, and the Sine of the opposite Angle, so I C is the Cosine of the Angle C F S, & Tangents and Cotangents are also the Tangents and Secants of Complemental Arches as F m and C m, are the proper Tangents and Secants of the Arch F O, which is the Complement of the Arch O S and consequently the Cotangent & Cosecants thereunto.

Corollary.

There can be no right Angled Δ whatsoever proposed but that there may be another discovered in all its Parts similar thereunto.

Scholium.

When any Angle is given to be solved; the first thing we have to do is to consider that here is in the Table of Logarithms, Sins Tangents and Secants, an Angle in all its Parts exactly Similar to that we are required to solve; and those sides are to one another in the same Proportion as the Δ proposed; also that whatever Ratio one side of the Triangle proposed

as to the other Side, about the Same Conssiderce, as Lengths, estimated or Numbered by any known Measures, as Inches, Yards, Miles, Leagues &c: The very Same have the two sides about the Same in the Tabular △ which being well understood, all Ingenious Trigonometry may be easily resolved by the following Observations.——

Observation. 1.

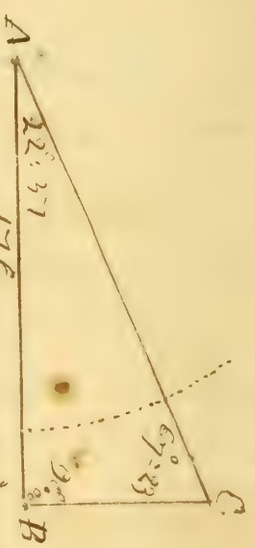
That the Proportion must be made between Sides and Sides and between angles and Angles.

Observatio. 2.

When a Side is required you are to begin with the Radius & an imaginary Side: And when an ∠ is required begin with the real Side.

Observatio. 3.

The first and third also the Second and last Terms, must be of the Same Value, as the Case is in the Golden Rule (Cap 12) Sides and Sides and Angles and Angles.



and Decimals I shall be your Directer and Counsellor, your Friend by Diligence

Trigonometrical Calculations.

Case first.

Given, the Base and Angles to find the Perpendicular.

Exam. { Base AB = 176
∠ at Base A — 22° = 37,
at the Radius = 90° = 00.
∠ at the Perpendicular C 67° = 23.

Canons.		Logarithms.
The Base ~~may be~~ made the Radius,		10, 000000
Is Radius	90° — 00	10, 000000
Base A B	176	2, 245513
Tangent of the ∠ at A	22° : 37	9, 619720
Perpendicular B C		11, 866233

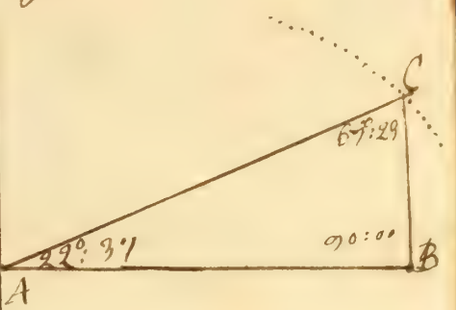
Answer — 73.

The Perpendicular made Radius.		
as is Tangent of the ∠ at C	67° : 23	10, 380279
Base at AB	176	2, 245513
Radius	90° : 00	10, 000000
Perpendicular BC		13) 12, 625513
		10, 380279
		03, 245234
		Answer 73

Of Right-angled Plain Trigonometry.

The Hypothenuse made Radius.

As the Sine of the ∠ at C	67°:23	9, 965248
Base A B	176	2, 245513
Sine of the angle at A	22°. 37.	9, 584968
		11, 830481
Perpendicular B C		9, 965248
		1, 865233
	Answer	73



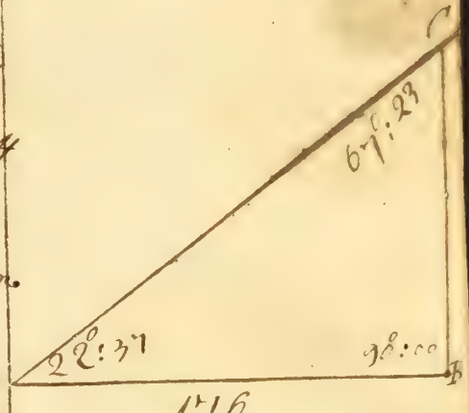
Scholium

Take out of the Tables of Numbers, Sines Tangents, & Secants, the Logarithm Answering the Numbers in your Propositions, & adding together the Logarithm of the second and third subtract from the sum the Logarithm of the first and the remainder shall be the Logarithm of that part required, by which means it becomes known.

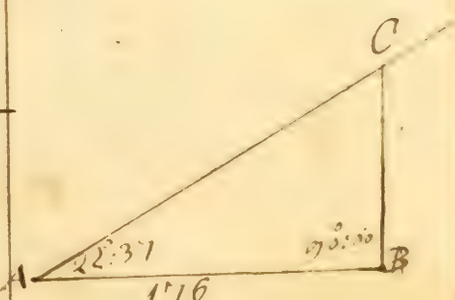
Case 2.

given the Base and Angles, to find the Hypothenuse.

Exam.		
	Base A B	176
	Angle at A	22°:37
	Angle at C	67°:23

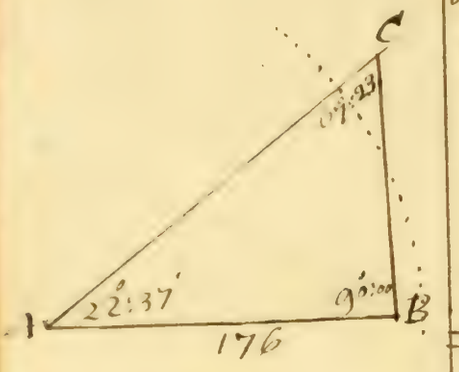


Hypothenuse A C made Radius, Logarithms		
as the Sine of the ∠ at C	67°:23	9, 965248
Base A B	176	2, 245513
Radius	90	10, 000000
		12, 245513
		9, 965248
Hypothenuse	190	2, 280265
	Answer	190



Base made Radius			
As Radius		90°:00	10, 000000
Base A B		176	2, 245513
Secant of the ∠ at A		22°:37	10, 034752
			12, 280265
Hypothenuse	190	the Answer	10, 000000
			2, 280264

Plain Rectangular Trigonometry.



Perpendicular made Radius. Logarithms

as the Tangent of the ∠ C = 67°:23 — 10,360279

Base AB — — 176 — 2,245513

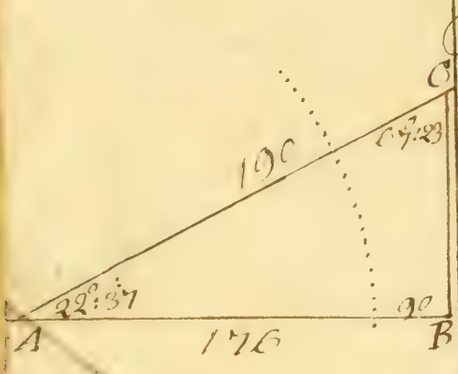
∴ Secant — — — — 67°:23 — 10,413032

12,660544

The Hypothenuse — — 10,360279

2,300266

the Answer 190.



Case. 3.

Given the Base & Hypothenuse, to find the Angles. Logms.

Exam. { Base AB 176 / Hypothenuse AC 190

The Hypothenuse made Radius.

As the Hypothenuse AC — 190 — 2,278754

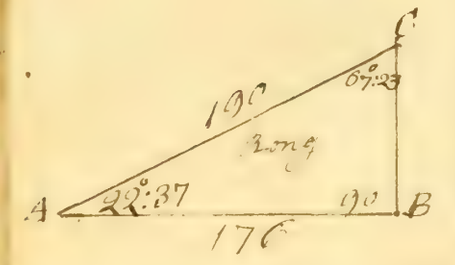
to the Radius — — — — 90°:00 — 10,000000

so is the Base AB — — 176 — 2,245513

12,245513

2,278754

the Sine of the ∠ at C — 67°:23 — 9,966759



The Base AB made the Radius. Logarithms.

As the Base AB — 176 — 2,245513

is to the Radius — 90°:00 — 10,000000

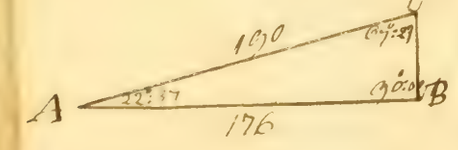
so is the Hypothenuse AC — 190 — 2,278754

12,278754

to the Secant of the ∠ at A — 22°:37 — 2,245513

10,033241

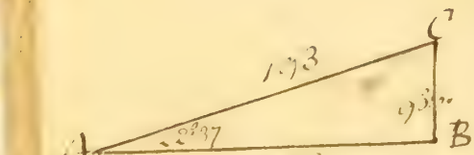
Answer



Case. 1.

The Base & Hypothenuse being given to find the Perpendicular

Exam. { Base. AB = 176 / Hypothenuse AC — 190 } { CB & before you can Form this, Observe in the Last Case find an ∠



Hypothenuse AB made Radius — Logarithms

as Radius — — 90°:00 — 10,000000

Hypothenuse — — 193 — 2,285557

Sine of the ∠ at A — — 22°:37 — 9,684968

11,870525

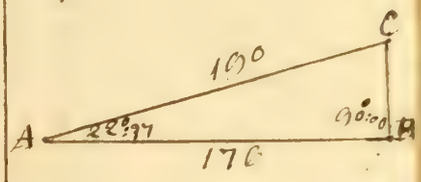
10,000000

Perpendicular — — — 73 — 1,870525

the Answer

Plain Rectangular Trigonometry.

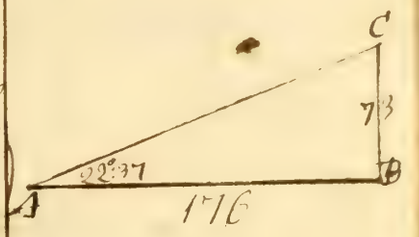
The Base made Radius.		Lograthms
Radius	90:00	10, 000000
Base AB	176	2, 245513
∴ Tangent of the ∠ A	22:37	9, 619720
		11, 865233
		10, 000000
Perpendicular	73	1, 865233



Case. 5.d

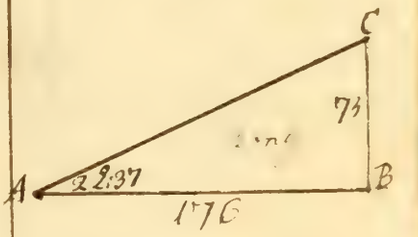
Given the Base & Perpendicular to find the Angles

Exam. { Base AB — 176 — ~~2, 245513~~
Perpendicular BC = 73



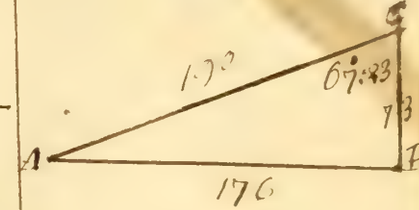
{ Base AB made Radius

As AB the Base	176	2, 245513
is to the Radius	90	10, 000000
So is the Perpendicular BC	73	1, 863323
to the Tangent of the Angle at A		11, 863323
		2, 245513
	22:37	9, 617810



{ Perpendicular made radius

As Perpendicular BC	73	1, 863323
is to the Radius	90:00	10, 000000
So is the Base AB	176	2, 245513
		12, 245513
		1, 863323
to the Tangent of the ∠ at C	67:23	10, 382190
Answer. 241		



Case. 6.

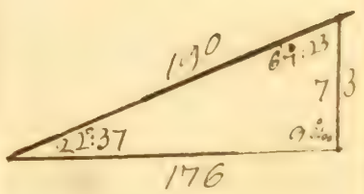
The Base & Perpendicular being given to find the Hypothenuse

Exam { AB the Base — 176
BC Perpendicular — 73

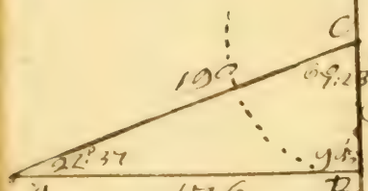
AB before you proceed you must by the last find the Angles

Base AB made Radius.

As the Radius	90:00	10, 000000
is to the Base AB	176	2, 245513
So is the Secant of the ∠ at A	22:37	10, 034752
		12, 280265
to the Hypothenuse	190	12, 000000
		2, 034755



Plain Rectangular Trigonometry.



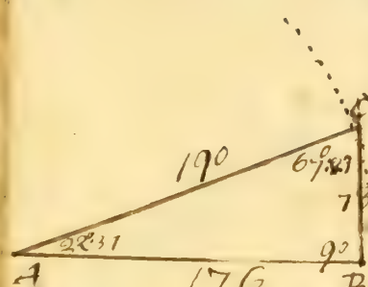
Perpendicular made Radius.

As the Radius —	90:00 —	10, 000000
Is to the Perpendicular BC —	73	1, 863323
So is the Secant of the ∠ at C —	67:23 —	1, 415032
		12, 278355
		10, 000000
To the Hypothenuse —	190 —	2, 278355

Case 7.th

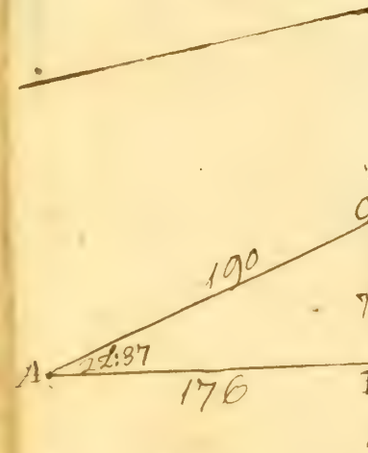
The Hypothenuse and Angles, given to find the Base and Perpendicular — Logarithms

Exam { Hypothenuse AC — 190
Angle A — 22:37
Angle C — 67:23



Hypothenuse made Radius.

As the Radius —	90:00 —	10, 000000
is to the Hypothenuse —	190 —	2, 278754
so is the Sine of the ∠ at C —	67:23 —	9, 965248
		12, 244002
		10, 000000
To the Base —	176 —	2, 244002



Hypothenuse made Radius.

As the Radius —	90:00 —	10, 000000
is to the Hypothenuse —	190	2, 278754
So is the Sine of ∠ at A —	22:37	9, 584968
		11, 863722
		10, 000000
to the Perpendicular —	73	1, 863722

Scholium.

All the fore-going Cases as well as those in Oblique-angled Trigonometry may be performed by Gunter's Scale by means of a Pair of Compasses which is called extending it, in order to which Seat I vary the Positions, making the Third Term the Second and the Fourth Term the Secand thus in the last it must be, as Radius is to the Sine of the ∠ A so is the Hypothenuse to the Perpendicular then putting one foot of the Compasses on the Radius of the Sines which is 90:00 & on the Radius of the Tangents which is 45:00 to the Numbers

= the second Number ending the other Number of Degrees of the same Species will reach on the Line of Numbers from those given to those required

Plain Obliquangular Trigonometry.

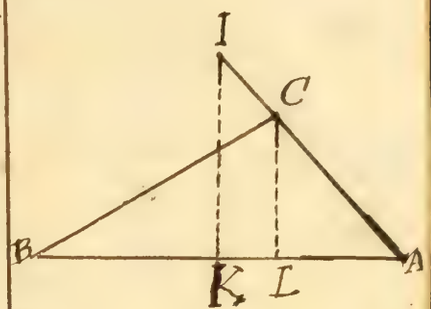
Axiom. 1.

In every Triangle the Sides are in Proportion one to the other, as the Sines of there opposit Angles.

Demonstration

In the Triangle ACB produce the Sides AC till the Side AI be equal to CB from CI let fall the Perpendicular CL & IK then is CL the Sine of the ∠ B & IK the Sine of the Angle A

As { AI is to IK / so is AC to CL }
As { CB is to IK / so is AC to CL }

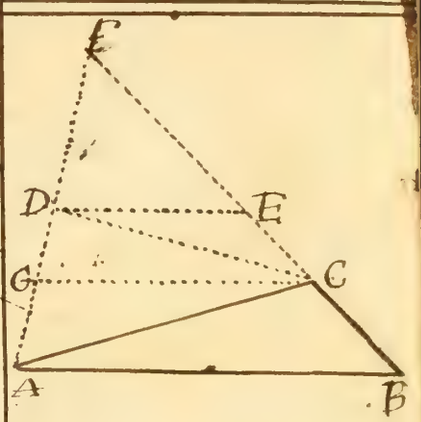


Axiom. 2.d

As the Sum of the Legs about any Angle is to their Difference so is the Tangent of half the Sum of the two other Angles to the Tangent of Half there Difference

Scholium.

In any Triangle, one Angle being known the Sum of the other two ∠s are known also (being what the given wants of 180°) if therefore the Difference of the ∠s can be found, by adding half the Sum and Half the Difference together it will give the greater of the two ∠s sought, and Half the Difference subtracted from the Half Sum leaves the lesser angle sought, and thus having found the Angles of a Triangle and Side being given it will be easy to find the other Side by the first Axiom.



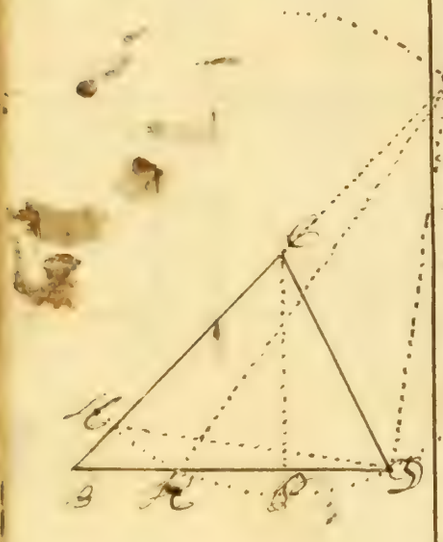
Axiom 3

In every plain Triangle it will be thus, as the Base is to the Sum of the other two Sides so is the Difference of the two Sides to the Difference of the Segments of the Base made by a Perpendicular let fall from the from the opposit Angle thereupon.

Plaine Rectangular Trigonometry

Construction.

on C as a Center with the Radius C D Describe the semicircle A E D. let the Lines D L. E D. & A M C. be drawn; let fall the Perpendicular C P. then is B E equal to the Sum of the Sides B C + Difference and A B - to the Difference of the Segments of the Base. viz of D C & C B.



Trigonometrical Calculations

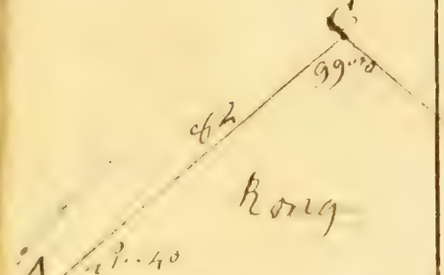
Case 1.

Two Angles and the Side opposit to one of them being given to find either of the other Sides.

Exam. { L. A 41:·10 / L. C. 99:·10 / Side A C. 82 / to find C B }

	41·10	
	99·10	
	140·50	
	180·00	
	140·50	
	39·10	Sagittarius

As Sine of the L B = 39·10 —— 9, 800427
is to the Side A C = 82 —— 1, 913814
so is the Sine Angle A = 41·40 —— 9, 822688
to the Side C B = 96 —— 11, 736502
9, 800427
1, 936075

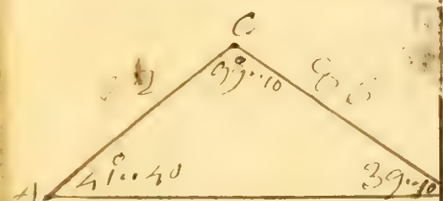


Case 2 & 3.

Two Sides and an Angle opposit to one of them being given to find the other angles & Side

Exam. { L. A 41·40 / Side A C 82 / Side C B 96 }

B. first to find the Angle B.



As the Side B C —— 96 —— 1, 934498
is to the Sine of the Lat A 41·40 —— 9, 822688
so is the Side A C —— 82 —— 1, 913814
to the Sine of the L B 39·10 —— 11, 736502
1, 934498
9, 802004

Plain Obliquangular Trigonometry.

2. to find the Side AB — Logarithms

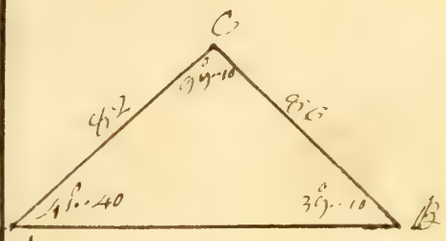
As the Sine of the ∠A — 41°..40 — 9,822688
is to the Side CB — 86 — 1,934498
so is the Sine of the ∠C — 99°..10 — 9,994418
to the Sine of ∠B — 39°..10 — 11.929916
9,822688
Side AB — 128 — 2,106228

Note 39°..10 + 41°..40 =
80°..50..180 — 40°..50
= 99°..10

Case 4th & 5th

Two Sides of a Triangle being given, & the contained, thereby to find the other other ∠s & Side. — first for the ∠s — Rule

(AB — 126
AC — 62
∠ABC — 41°..42



As the Sum of the two Sides AB & AC 210
so is the Difference — 46
to ½ the Sum of the Tangents of the unknown ∠s 69..9
so is the Tangent of half there Difference

Logarithms
2,322216
1,662758
10,419611
12,082369
2,322216
Ans°..30 — 9,760153

AB 128 + AC 82 = 211 the Sum of the Sides. 128 − 82 = 46 the Difference, 180°..41
40 = 138°..20' the unknown Angles, thence the Difference of the unknown Angles = 38°..00 Now by Scolium of Axiom, 2nd

(69°..10 + 38°..00 = ∠ACB = 99°..10
(69°..10 — 38°..00 = ∠CBA — 39°..10

Plane Obliquangular Trigonometry.

2.d To find the Side CB.

As the Sine of the ∠ B	36. 10	9, 600427
is to the Side AC	82	1, 913814
so is the Sine of the ∠ A	11. 40	9, 822688
		11, 736502
		9, 600427
To the Side BC	86	1, 936075

Case C.

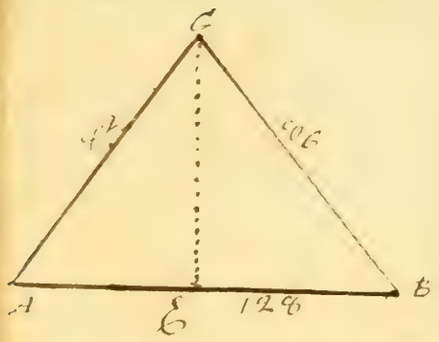
Given the three Sides to find either of the ∠s.

BC + AC = 168 —
BC − AC = 4 —

Exam. AB = 128, BC = 86, AC = 82

As the Base AB	128	2, 107209
is to the sum of the Sides AC + CB	168	2, 225309
so is the Difference of AC & CB	4	0, 602060
to the Difference of the Segments of the Base BD	6	2, 827369
		2, 107209
		0, 720160
Then AB 128 − DB = 6 = AD	122	

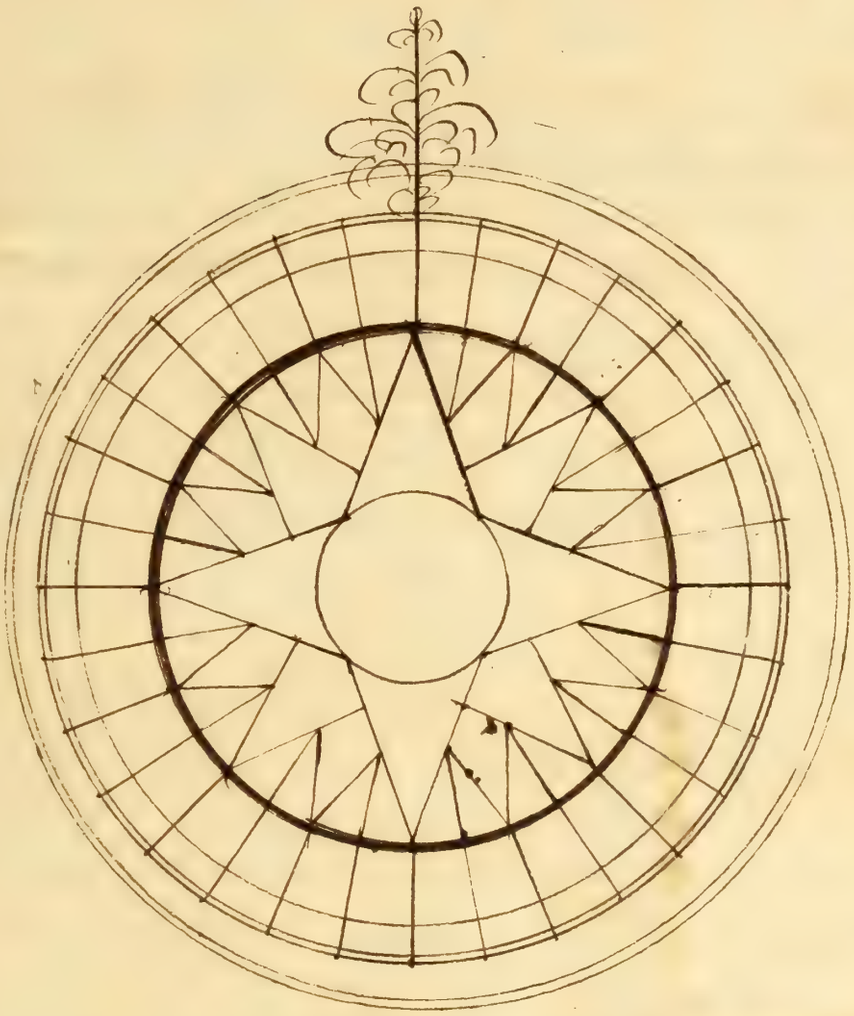
AD + 2 = AE = ED = 61 + DB = 6 = EB.

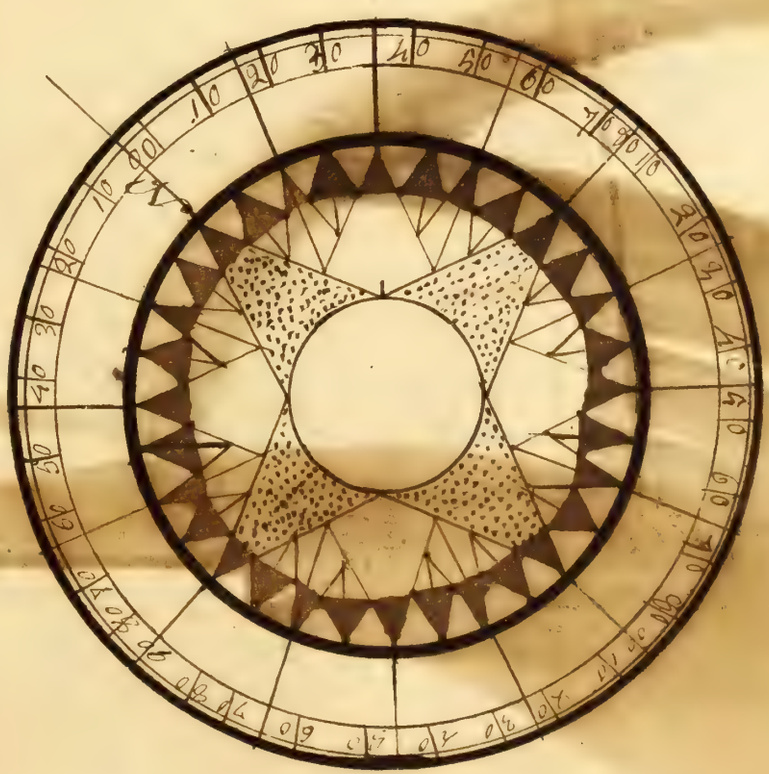


	Logarithms
As the lesser Segment AE = 61	1, 785330
Is to the Radius	90. 00 — 10, 000000
So is the Side AC	82 — 1, 913814
	11, 913814
	1, 785330
To the Secant of the ∠ at A = 48. 40	10, 127484

As the greate Segment ED = 67		1, 826075
is to the Radius	90. 00	10, 000000
So is the Side CB	86	1, 934498
		11, 934498
		1, 826075
to the Secant of the ∠ at B	36. 10	10, 108423

Then 180 — 90. 50 = to the ∠ A + B = 89. 10 = 2 C — Sines.





Navigation.

Navigation or Sailing is divided into three Kinds, Plain, Mercator & Circle Sailing. Plane Sailing supposes the Earth and Sea to make one flat Superficies, in which the Meridians are parallel & the Degrees of Longitude & Latitude are supposed to be all equal. Upon this Hypothesis the Plane Chart is drawn. the Uses of which for finding the Latitude and Longitude. Bearing and Distance as Increase much the same with Common Maps.

In the Practice of Navigation the Chief Purpose is the conducting a Ships to any Port, & the finding the Longitude & Latitude she is at any time in the Performance of which the Mariner has these helps, The Compass by which the Ships Course is known, the Log-Line by which he knows her Distance & the Latitude known by Observation

One Each Degree is supposed to be divided into 60 Minits or Miles. and 20 Leagues are equal to one Degree. N B one of these Miles ~~are equal~~ is larger than a Statute mile containing 6000 feet, whereas the latter contains no more than 5280 Feet

A General Rule to find the Difference of Latitude where the Latitude of two Places is given

The Latitudes being being both North or both South being Subtracted the one from the other gives their Difference of Latitudes. being one North the other South gives it ~~added~~ added findeth Difference of Lat.

A General Rule to find the Lat. the Ship is in having the Lat. departed from and the Diff. of Lat. Given. for this we have 2 Cases.

(Case 1st) North / South } Lat. Sailing to the { South / North } ward, the Lat increases add.

2d { North / South } Lat. Sailing towards the { South / North } decreases Subtract the Diff. and you have the Lat of the Ship

N B. when the Lat decreases & the Diff. of Lat. is greatest and the Ship has croped the Equinoctial Line, and the Ships has changed her Lat. then Subtract the Lat. given from the Diff. the remainder is the Lat. on the other Side of the Equinoctial.

Navigation.

Plain Sailing is divided into three Parts, which is resolved
1. by an Right Angle Triangle relating to a Single Course. Page 1st
2. by an angled Triangle relating to several Courses call commonly called
3. by an Oblique Angled Triangle in which are 4 Cases but a multitude
of Questions. N. B. Diff. of Long. or ~~Dep~~ Departure from the Meridian
is the Distance East or ~~West~~ West on a Parallel. ~~Difference~~ of Lat. is the distance
ance North or South on a Meridian.

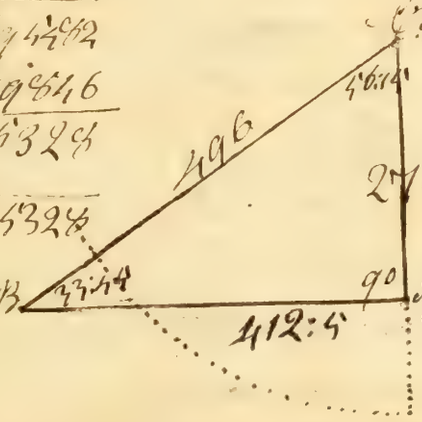
Problem. 1. The Course & Distan. run given; to find the Diff. of
Lat. & Departure from the Meridian.

Exam. } Admit a Ship run 496 Miles S.W. by W. from Lizard
in 60 Degrees North Lat. required the Latti. She is in and how
far She is Departed from the Meridian

As Radius --- 90 --- 10, ------
is to the Hypot. 496 --- 2, 695462
so is the Sine of ∠ C: 56:15 --- 9, 919646
to its opposite side 412:5 --- 12, 615324
10
2, 615324

As Radius: 90 --- 10 ------
: Hypot.: 496 :: 2, 695462
:: As Sine of ∠ B: 33:45 --- 9, 744739
: Diff. of Lat 276 --- 12, 440221
10
2, 440221

60 | 276 (4:36
The Lat. she Left 56
4 - 36
The Lat. she is now in 59:24



~~The Latt. she Left 56:15~~
~~The Lat. she is now in 6:44~~

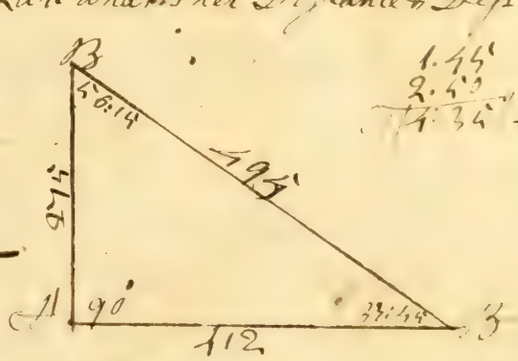
---

2 Course & ~~Distance~~ Diff. of Lat. given, to find the Dist. run & Dep. from Meridi.

Exam. } If a Ship runs S. E. by E. from S: 45 No. Lat. and then by
Observation She is in 2:30 S. Lat. what is her Distance & Departure.

As the Sine of ∠ 33:~~45~~ 45' --- 9, 744739
is to the Side --- 275' --- 2, 439333
so is the Radius --- 90 --- 10, ------
to the Distance 495' 12, 439333
9, 744739

As Radius --- 90 --- 10, ------
: is to Side --- 495 --- 2, 694605
so is Sine of ∠ 56:15: 9, 919646
to the Side AB 412 12, 614251
10
2, 614251

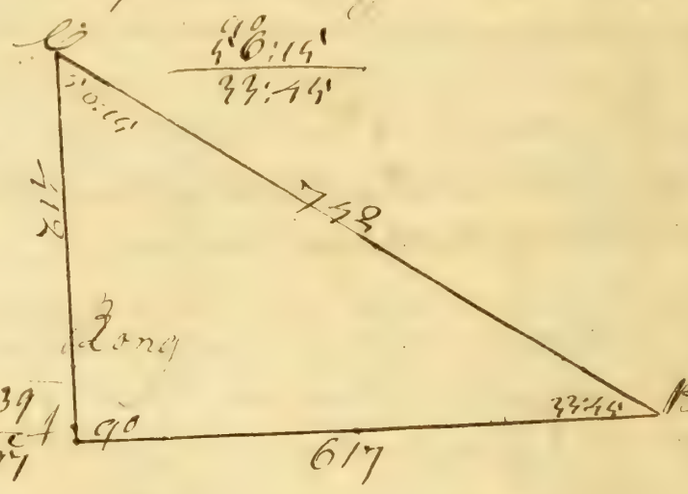


1. 45'
2. 45'
4. 30' 275'

Plain Sailing.

3. Course & ~~Distance~~ Departure from the Meridian given; to find the Distance & Diff. Lat.

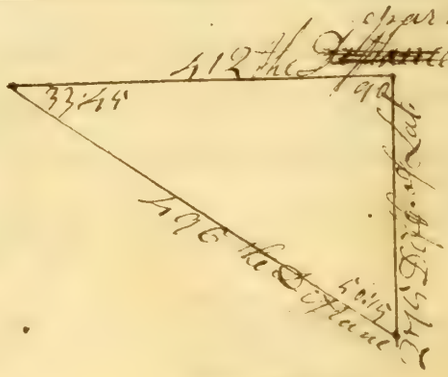
Example. A ship sails S. & E. by S. from B. 15 S. Lat. untill she Depart 412 m. from the Meridian. ——— Required her Distance & what Lat. she is in?



As Sine of ∠ B = 33:45' :: 9,744739
is to the side AC = 412 :: 2,614697
so is Sine of ∠ C = 56:15 9,919846
to its opposite Side 617 12,534543
9,744739
2,790004

As the Sine of ∠ B = 33:45' :: 9,744739
is to the Side AC = 412 :: 2,614697
so is the Radius 90° 10,
to the Side AB 742 12,614697
9,744739
2,870,958

As the Sine of ∠ 56:15 :: 9,919846
is to its opposite side 412 :: 2,614697
:: Radius 90° 10,
to its opposite side 496 12,614697
9,919846
2,695051



As the Sine of ∠ 56:15' 9,919846
: to its opposite side 412 2,614697
: Sine of ∠ 33:45' 9,744739
12,359636
Its opposite side 275 9,919846
2,439790

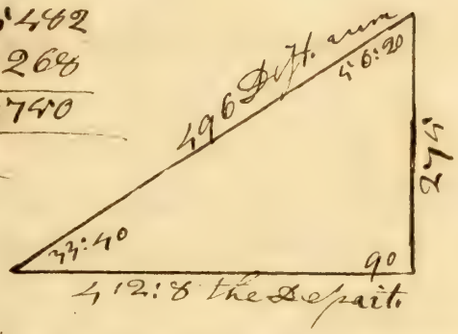
4:34'
3:15'
the Lat. she is now in 7:49'

Problem 4. Distan. & Diff. of Lat. given: To find the Course & Depar.

Exam. Suppose a Ship runs 496 m. between S. & W. from a Port in 2:48' N. Lat. & then by Observation is found to be in 7:23' S. Lat. What Course she steered and what Depar. she made?

As the Distance run 496 2,695482
: Radius 90 10,
:: the Diff. Lat 274 2,437933
12,437933
2,695482
: to its oppo. ∠ 33:30 9,742451

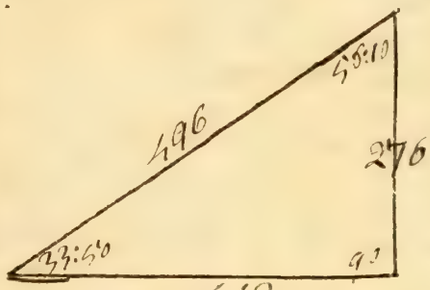
As the Radius - - - 90 - 10 - - -
is to the Distance - - 496 - 2,6954482
Sine of ∠ - - - 56:20 - 9,9202648
- to the Departure - 2,6154740
from the meridian. = 412:8 -



Roblem 5. Distance & Depart. given; to find the Course & Lat.

Exam. Admit a Ship runs 496.m between N. & W. until her Depart. be 412. what is her Course and what is her Diff.s of Lat.s - - - - - - - - - - - - - - - -

As Radius - - - - - - 90
is the Distance run - - 496 - - 2,6954482
so is the Radius - - - - 90 - 10, - - - - -
: the Depart. - - - - 412 - 2,6148697
to its opposit ∠ - - - 56:10 - - 12,6148697
2,6954482
9,9194215



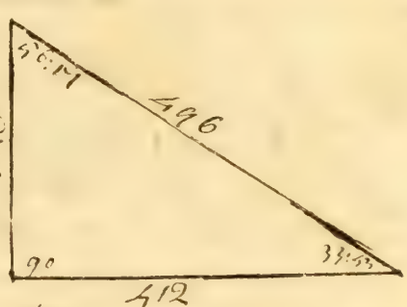
Answer the runs S. W. by W.

As Sine of ∠ 56:10 - 9,9194424
Departure 412 - 2,6148697
: Sine of ∠ - - 33:50 - 9,7445683
Diff. of Lat. 276 - 12,3604580
9,9194424
2,4411156

Roblem 6. The Diff.s of Lat. & Depart. given; to find & find Course & Dist.

Exam. If a Ship Southing be 275 Minnits & her Easting 412m. what is her Course & Distance. - - - - - - - - -

As the Departure - 412 - 2,6148697
is to Radius - - - - 90 - - 10, - - - -
so is the Diff. of Lat. - 275 - - 2,4393333
to its opposit ∠ - - 33:43 - 12,4393333
2,6148697
9,8244636



As ~~Radius~~ Sine of ∠ - - 56:17 - 9,9200114
: the Departure - - 412 - 2,6148697
: the Radius - - - - 90 - - 10, - - - -
to the Distance run - 496 - 12,6148697
9,9200114
2,6948583

Answer She runs S. E. by E. her Distance is 496 Miles.

Caleb

A Part of Plain Sailing shewing how to resolve a Traverse.

A Traverse is when a Ship meeting with Contrary Winds, Sails on several Courses in 24 Hours. To resolve a Traverse is to reduce several Courses in to one, these Courses are known by the Compass and the Distance by the Log. — The Log is a Flat Peice of Board about 7 Inches long & fastned to a Small Cord called the Logline at one End with so much Lead at the other End that when Put in to the Sea will Swim upright.

The Course and Distance run on each Course are set down in a Table drawn by several Collams as convenience may Direct.

N. B. when a Ship Sails by a Wind, it is usual to allow one Point for ~~several~~ Leeward way, so that when a Ship. E. by S. Lays 5 Points and a Half from the Wind, her Course corrected is 6 Points and one Half from the Wind. ———

To draw a Traverse or lay it down by Trail and Compasses, take the following Rules which give the Points between each Course called the ∠ between both Courses. ———

I. Two Meridians & two Parralells the lesser Course Subtracted from the grater, gives the Angle between the Courses. ———

II. Two Meridians and one Parallel add both Courses together. ———

III. One Meridian and two Parralells subtract the Sum of both Courses from 16 Points.

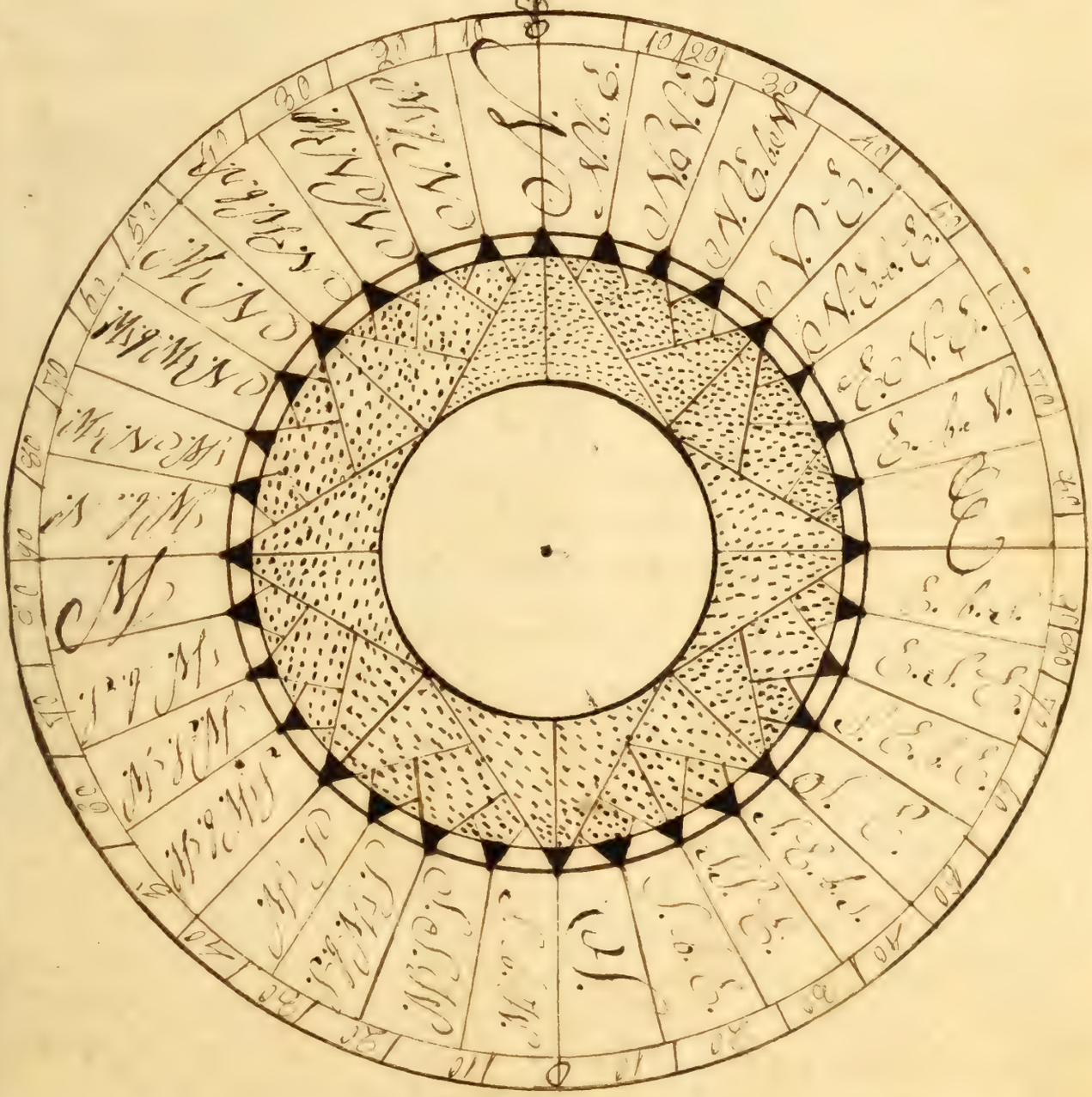
IV. One Meridian & one Parrallel, add 8 Points the Lesser Course & the Complement of the grater together the Sum is the Said ∠.

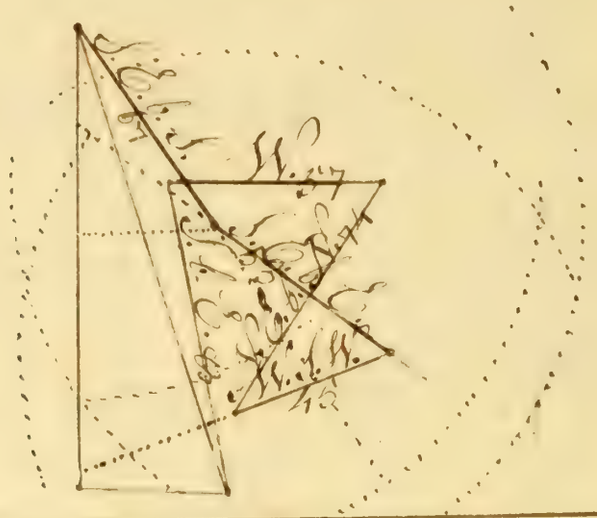
N. B. North & South are called Meridians, East & West are called Parralells. By Complements of the grater Course understand how much it wants of 8 Points to know the Meridians and Parralells the first and Second Courses are compared together the Second and 3 and ~~4 and 5~~ third and 4. ———

Ex. A Ship Bound to a certain Port meeting with contrary winds. Sails first S. E. by S 67 Miles then So the E. by E. 32 Miles then West S. 45 Miles then N. E. by N. 14 then West 57 and then S. by E. ~~75~~ 83. I Demand the Diff. of Lat. Departure from the Meridian and Direct Course and the Distance from the first Place of Departure. ———

Rule. Set down the Several Courses and Diffs with the Points from the Meridian &c. as in the following Table. In the first Colum put the Point for laying down which are found by the foregoing Rules for the first Course if to ward the Same with the Points from the Meridian. ———

Numbers	Courses	Distance	Diff. of Longitude by Middle Latitude	Diff. of Longitude by Plaining the Arch	Diff. Lat. North	Diff. Lat. South	Departure East	Departure West
1	S. E. by S.	67	3	3				
2	S. E. by E.	53	5	14				
3	W. S. W.	45	6	5				
4	N. E. by N.	74	3	3				
5	W.	57	4	5				
6	S. by E.	83	1	7				





As Radius : 90 :: 10, ...
: Diff. . . 67 : : 1, 826075
: : Cosine of 23 : : 9, 919846
: Depart. 56. 11, 745921
10
1, 745921

As Radius . . 90 . . . 10 . . . . .
: Diff. . . . 67 . . . 1, 826075
: : L . . . . 23 . . . 9, 744739
: Depart. . 37 . . . 11, 570814
10,
1, 570814

Course 3.
As . . of Points . . . 10
: . . . 53 . . . . 1, 724276
: : . . 5 Points . . 9, 919846
: : Depar. from Merid. 11, 644122
44 = 1, 644122

2 Course As : of Points . . . 10,
: . . . 53 . . . . 1, 724276
: : . . 3 Points . . 9, 744739.
: Depar. from Merid. 11, 469015
Diff. Lat. 29:4 10
1, 469015

As of Points . . . 10,
: 43 . . . . 1, 643212
: . . . 3 . . . . 9, 942640
: : 2 Points . . . 1, 236852
: Diff. Lat. . . 17 =

Course 3.
As . . of Points . . . 10
: Diff. . . . 15 . . . 1, 643212
: : 6 Points . . . 9, 964615
: : Depar. from Merid. 11, 614827
41 10
1, 614827

As of Points . . . 10,
: Distance . . 11 . . 1, 869232
: : 5 Points . . . 9, 919846
: Diff. Lat. 61 . . 1, 789078

Course 4.
As of Points 10,
: Diff. 24 . . . . 1, 869232
: : to 3 Points . . . 9, 744739
to Dep. Merid. . . 41 . . 1, 613971.

As of Points . . . 10
: . . . 83 . . . 1. 919078
: : 1 Point . . . 9, 290236
: Dep. from Merid. 9, 209314
16:2 1, 209314

As of Points . . . 10,
: . . . 67 . . . 1, 745814
: : of Points . . . 10,
10. 47 . . . . 1, 745814

As of Points . . . 10,
: . . . 83 . . . 1, 919078
: : 7 Points . . . 9, 916574
To Dep. from Merid 61:4 1, 910652

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Cosine of 23 . . 9, 919846
: Depart. 56. 11, 745921
10
1, 745921

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : L . . . . 23 . . . 9, 744739
: Depart. . 37 . . . 11, 570814
10,
1, 570814

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Tangent of 23 . . 9, 632071
: Depart. . 56. 11, 458146
10
1, 458146

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Sine of 23 . . . 9, 592213
: Depart. . 26. 11, 418288
10
1, 418288

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Secant of 23 . . 10, 032213
: Depart. . 73. 11, 858288
10
1, 858288

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Cosecant of 23 . 10, 407354
: Depart. . 29. 11, 233429
10
1, 233429

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Cotangent of 23 . 10, 367354
: Depart. . 28. 11, 193429
10
1, 193429

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 23 . 8, 407354
: Depart. . 3. 10, 233429
10
0, 233429

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 67 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 113 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 157 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 203 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 247 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 293 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 337 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 383 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 427 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 473 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 517 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 563 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 607 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 653 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 697 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 743 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 787 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 833 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 877 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 923 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 967 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1013 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1057 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1103 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1147 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1193 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1237 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1283 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1327 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1373 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1417 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1463 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1507 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1553 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1597 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1643 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1687 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1733 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1777 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1823 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1867 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1913 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 1957 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2003 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2047 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2093 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2137 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2183 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2227 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2273 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2317 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2363 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2407 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2453 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2497 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2543 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2587 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2633 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2677 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2723 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2767 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2813 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2857 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2903 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2947 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 2993 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3037 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3083 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3127 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3173 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3217 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3263 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3307 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3353 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3397 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3443 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3487 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3533 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3577 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3623 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3667 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3713 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3757 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3803 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3847 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3893 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3937 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 3983 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4027 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4073 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4117 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4163 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4207 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4253 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4297 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4343 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4387 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4433 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4477 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4523 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4567 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4613 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4657 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4703 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4747 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4793 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4837 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4883 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4927 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 4973 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5017 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5063 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5107 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5153 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5197 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5243 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5287 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5333 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5377 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5423 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5467 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5513 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5557 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5603 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5647 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5693 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5737 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5783 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5827 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5873 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5917 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 5963 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6007 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6053 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6097 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6143 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6187 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6233 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6277 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6323 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6367 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6413 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6457 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6503 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6547 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6593 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6637 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6683 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6727 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6773 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6817 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6863 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6907 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6953 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 6997 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7043 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7087 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7133 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7177 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7223 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7267 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7313 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7357 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7403 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7447 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7493 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7537 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7583 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7627 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7673 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7717 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7763 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7807 . 9, 633972
: Depart. . 43. 11, 460047
10
1, 460047

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed Sine of 7853 . 10, 000000
: Depart. . 67. 11, 826075
10
1, 826075

As Radius . . . 90 . . . 10,
: Diff. . . . 67 . . . 1, 826075
: : Versed S

Traverse Sailing

As the Diff. of Lat.	71 : 41	9,977834
is to the Diff. of Lat.	122	2,086359
so is Radius	90	10
		12,086359
to the Departure	124 3/10	9,977834
		2,108524

For the Second Course.

This is 1/4 Point, found by comparing the 1st Course & 2d another in which are one Meridian & one Parallel & by the 4th Rule makes 1/4 Point for laying down, again comparing the 2d & 3d Course together it is one Meridian & two Parallels which by the 3d Rule makes 1/2 Point for laying down. Again the 3d & 4th Courses compared together it is two Meridians & two Parallels which by the first Rule makes 3 Points for laying down, Again for the 4th & 5th Courses it is one Meridian & two Parallels, which by the 3d Rule gives 2 Points for laying down Again the 5th & 6th Courses compared is is two Parallel & one Meridian which by the 3d Rule gives 1 Points. by the 1 Points for laying down it is easy to delineate the Traverse thus first draw the Meridian A B of any convenient length, and with a Chord of 60 make an Arch on which from your Line of Rums on your Scale lay off three Points by it draw a No. E by S. Line laying thereon by the Distance from S. E by E. with a Chord of 60 with one foot on the End of the S. by E. Line draw an Arch on which lay 1/4 Points there draw a S. E. by E. Line Making it 53 Miles long

B At the End of the S. E. by E. Line at the Chord of 60 on the Arch and Lay 3 Points by which and the End of the S. E. by E. Line draw the S. W. S. S. W. Line 45 Miles long and after the same manner draw the So. E. by S. 74 Mls then the West Line 57 Mls then the S. by E. Line 63 Mls Ending at C Where the Ship now is. Lastly draw a Line from A to B and from C let fall the Perpendicular C D then is A D the Ships Distance from the Place of Departing & B D the Diff. of Lat. & A B the Departure from the first Meridian. Then by the first Case of Plain Sailing, find the Diff. of Lat. & Depar. Meridian for these Courses Severally

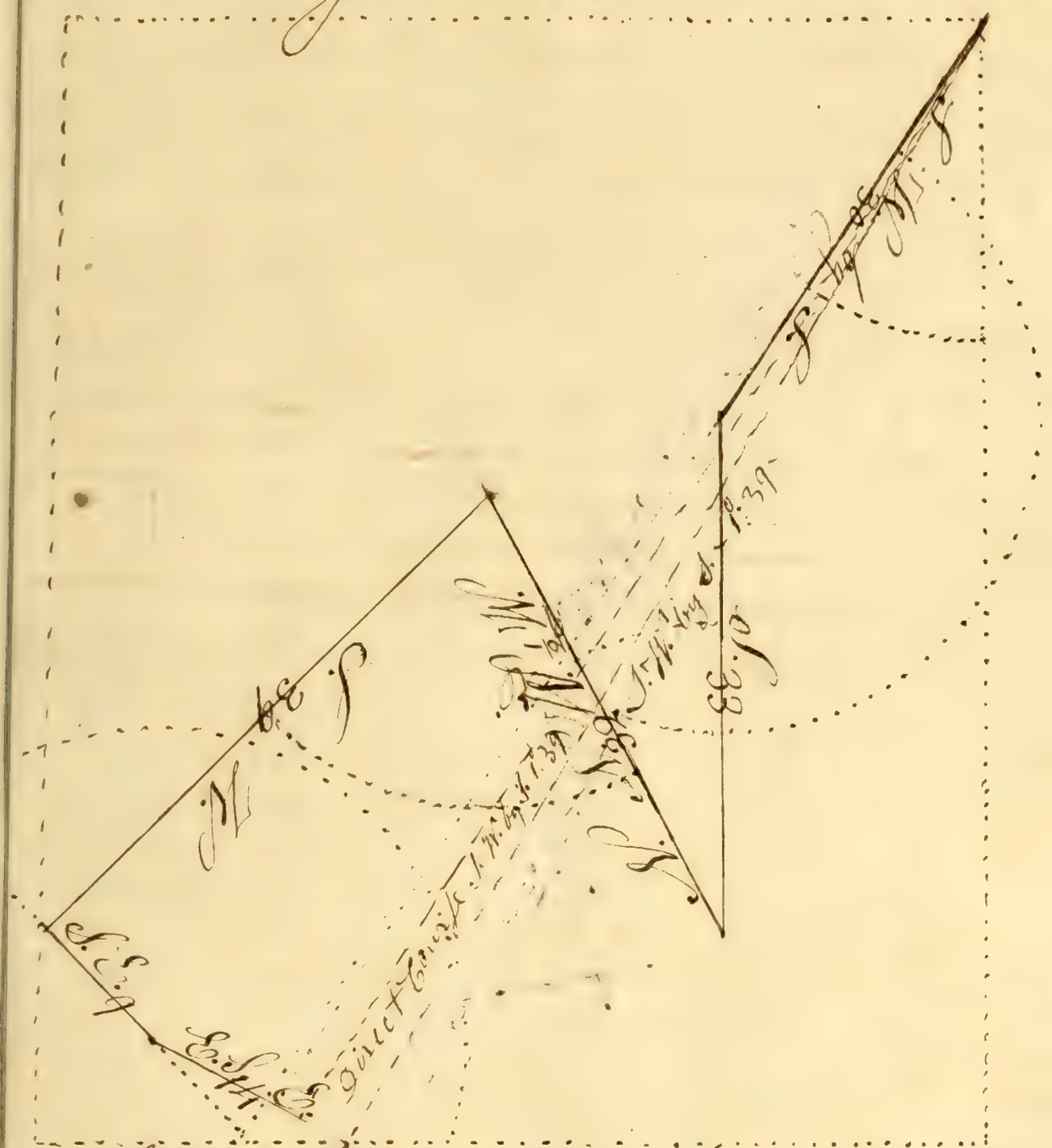
Navigation or Plain Traverse Sailing.

Suppose in 24 hours a Ships sailings & Courses. 1. S.W. by S. 30 Miles
2. S. 33. 3. S. S.W. ½ W. 32. 4. S.W. 39. 5. E. by S. & E. by S. E. 11 Miles.
What is her Diff.t Lat. Depart. & Direct Course & Distance.

	No.	Courses.	Distance	N.t from Meridian	W.t or Easterdom	Diff.t Lat. N.	Diff.t Lat. S.	Dep.t from Meridian E.	Dep.t from Meridian W.	
	1	S. S.W. by S.	30	3	3		24.9		16.7	
	2	S.	33	0	0		33			
	3	S. S.W. ½ W.	32	2½	2½	28.2			11.1	
	4	S.W.	39	4	6½		27.6		27.6	
	5	S. E.	9	4	4		6.4	6.4		
	6	E. S. E.	11	6	11		4.2	10.2		
						28.2	96.1	16.6	49.4	

28.2 / 67.9 — 16.6 / 32.8

Navigation in Traverse.



As the Diff. Lat. - - 67.9 - - - 1,826658
is to Radius - - - - 60 Pints - - - 10,
so is the Dep. from Merid. 42.8 - - 1,624076
To the Tangent of 2 - - 32:6 - - - 11,624076
1,826658
9,797418

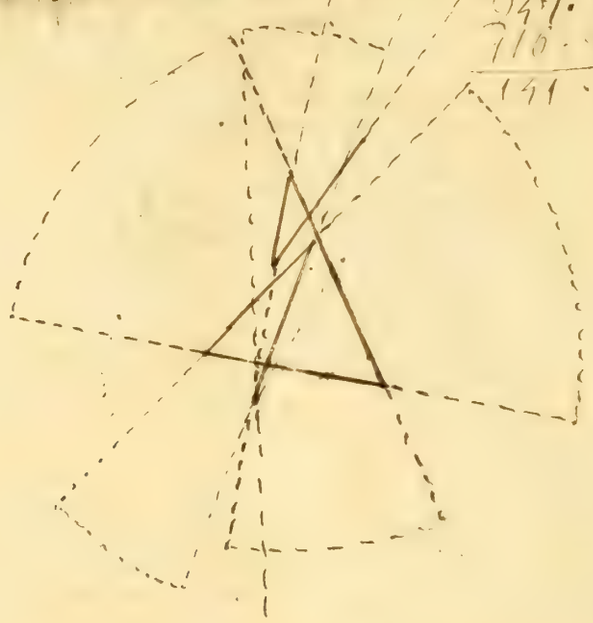
As Sine of 2 57:54 - - - 9,927946
is to the Diff. of Lat. 57.9 - 1,826658
so is Radius 60 Pints - - - 10,
to the first Place of Dep. 79:2 - 11,826658
9,927946
1,898712

Navigation in Seamanship.

Exa 3. If a Ship sails by a Log board in 24 Hours as follows
North E. S. E. 63. S. W. 7 4 m. E. by S. 92. E. S. E. S. W.
126. S. by W. 47 & S. E. by S. 75. Require the Diff.
Lat. Departure Direct Course & Distance run.

	Courses	Diff.	Points from the Meridian	Points Sailed by	Diff. Lat. N.	S.	Departure E.	W.	
1	N. N. E.	63	2	2	116·7		31·6		
2	S. W.	7 4	4	2		52·3	52·3		
3	E. by S.	92	7	5		141·9	90·2		
4	S. S. W.	126	2	5	116·4			48·2	
5	S. by W.	47	1	3		10·1		9·2	
6	S. E. by S.	75	3	2	64·9		43·3		

141·9 − 116·3 = 25·6 (104·6 / 45·7)
116·4
141·6



1. Diff. Lat. — 141.6 — 2,151063
Radius — 10
Departure 63·7 — 1,740914
Tangent of ∠ 21·3 — 11,740914
2,151063
9,589852

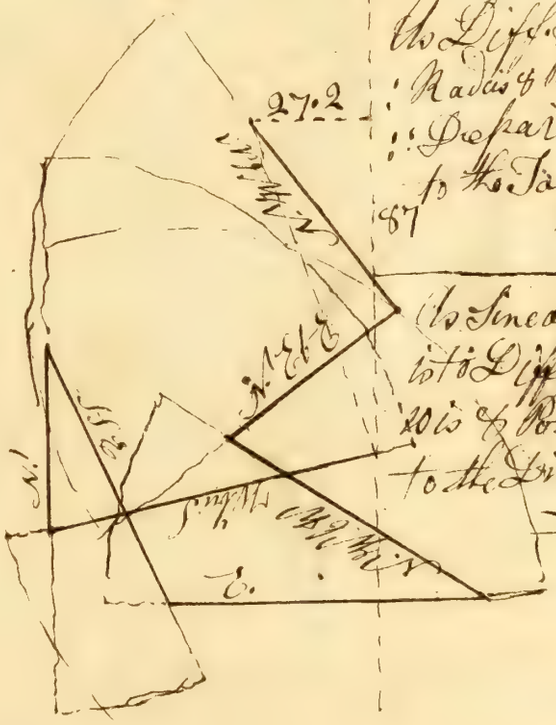
As Sine ∠ — 68·45 — 9,969519
Diff. — 141,6 — 2,151063
Radius 10,
12,151063
2,969519
Distance 152·2 — 2,181544.

Navigation Traverse.

Ex. 4 { If a Ship sails W. by S. 67 N. 46. S.S.E. 75 E. 83 N.W. by W. 79 N.E. by E. 57 & N.W. by N. 64 require Diff. of Lat. Departure Direct Course & Distance run.

Courses.	Diff.	Pts from the Meridian	Pts of Laying down.	N	S	E	W
N.b.W.	67	7	7		~~17~~		65.3
N.	46	0	7	46	16.6		
S.E.	75	2	2	43	69.3	28.7	
E.	83	6	10	~~43.7~~31		83	~~65.7~~
N.W.b.W.	79	5	3	~~46.8~~ 77			65.7
N.E.b.E.	57	5	6	~~48.7~~		47.4	
N.W.b.N.	64	3	8	~~53.2~~ 53.2			35.5
					~~86.6~~ 65.9	159.1	186.3 / 159.1 / 27.2

Answer Diff. Lat 67 Departure ~~126.5~~ ~~42.5~~ 173.2 ~~86.2~~ 67.
from the Meridian 27.2
Distance run 91.2 Direct Course
N.W.b.W. 5° 45' W.



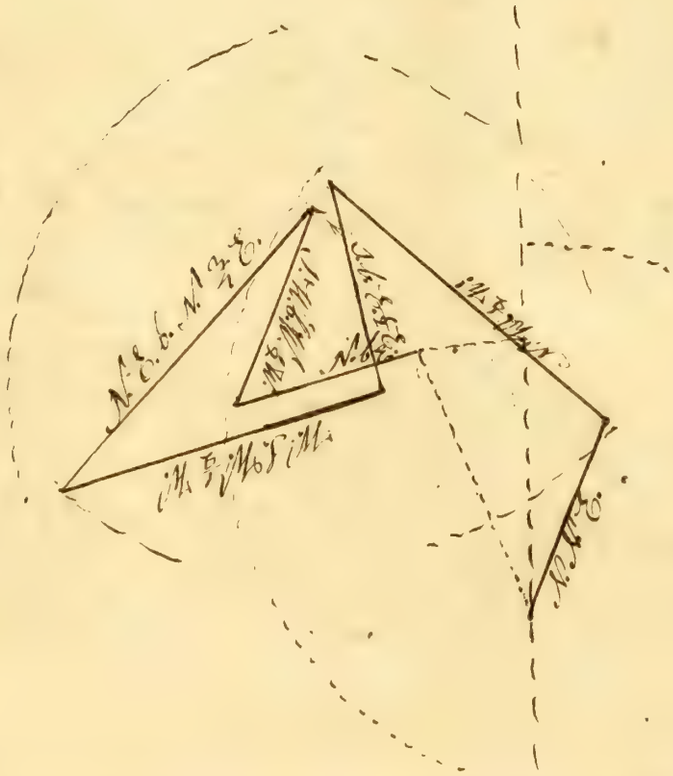
As Diff. Lat. 67 — 1,939519
is Radius Points — 10 —
so Departure 27.2 — 1,431885
to the Tangent of 17:15 — 1,431885
1,939519
9,492166

As Sine of 72:45 = 9,980364
is to Diff. Lat. 67 = 1,939519
20 is 4 Points — 10 —
to the Direct course = 91.2 — 1,939519
9,980364
1,959155

Navigation & Traverse.

Ex. 5. If a Ship sails as follows. N. N. E. 55.
N. W. ½ W. 96 S. by E. ½ E. 57 W. S. W. ½ W. 69.
N. E. by N. ¾ E. 100. S. W. by W. ½ W. 54 & N. by E. 50.
Required Diff. of Lat. Depart. Direct Course & Distance run.

	Courses	Distance	Pts. from N. & S.	Pts. for Larger Part	Diff. Lat. N.	Diff. Lat. S.	Depart. E.	Depart. W.
1	N. N. E.	55	2	2	50.6		21.0	
2	N. ½ W.	96	1 ¼	9 ¾	64.5	~~55.3~~		71.1
3	S. b. E. ½ E.	57	1 ¼	3		55.3	13.6	
4	W. S. W. ½ W.	69	6 ½	4 ¼		26.8		66.2
5	N. E. b. N. ¾ E.	100	3 ¾	2 ¾	67.2		74.1	
6	S. W. b. W. ½ W.	54	5 ½	1 ¾		~~47.6~~ 26.5		~~25.3~~ 47.6
7	N. by E.	50	1	4 ½	49.0		9.6	



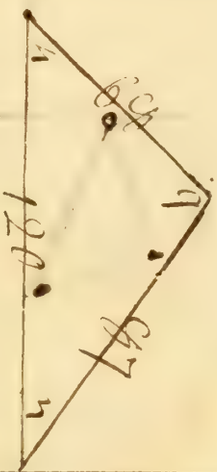
Oblique Sailing.

Oblique Angled Trigonometry Applied in Questions of Oblique Sailing.

Ex. 1. Suppose two Ports A & B lie N.W. & S.E. of a Ship sails from the Northermost N.E. 68 m. Another from the Southermost off Port A lies N.W. & the Ship meets the first Ship required the Distance of the Ports and Distance which each Ship run.

As 3 Points = 9,744739
is to 6 = 1,602509
so 3 Points = 9,949495
to its opposit side = 11,552004
= 68. 9,744739
1,807265

As 3 Points = 9,744739
is to 6 = 1,602509
so 11.9 Points = 9,991574
to its opposit side = 11,594083
= 120 9,744739
2,079344



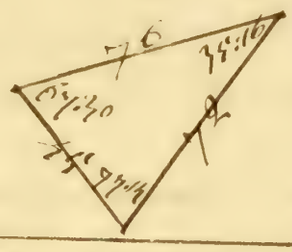
In what Distance of the Ports 12 m the Distance run of the last Ship 68 m the other 47.

Ex. 2. Suppose 2 Ports N.W. & S.E. of a Ship sails from the Southermost N.E. 45 m another from the Northermost runs 72 & then meets with the first. The Course of the last and the Distance of the Ports is required.

As Sine of ∠ 35:10 = 9,761464
: the Distance 45' — 1,653212
So is the Sine of ∠ 77:14 — 9,969124
to the Diſtance — 11,622336
from the ∠ 76 — 9,761461
1,860875

As Sine of ∠ 67:30 — 9,965615
: 45' — 1,653212
So is the Sine of ∠ 35:10 — 11,618827
to the Diſtance — 1,547332
9,761495

Anſwer the Diſtance between the Ports 76m per Direct Courſe S.W. by S. 1:31 S.

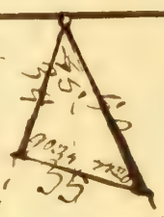


Two Ships ſail from a certain Road; the one ſails S.S.E. 6m the other S.S.W. 3m Required their Bearing and Diſtance.

As the Sum of the two Sides 9 — 1,929419
is to their Difference — 15 — 1,176091
ſo is the Tangent of the Sum of the 2 oppoſite ∠s 67:30 — 10,382716
to the Tangent of half the Diff. of the two ∠s 23:4 — 9,629419

1 0 9
3 6
1 3 5
6 7 : 3 0

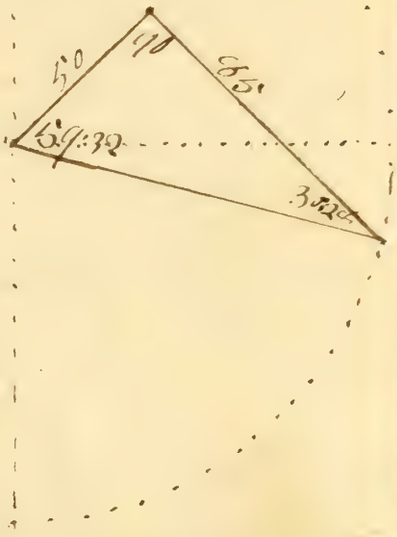
As Sine of ∠ 44:26 — 9,845141
: the Side — 35 — 1,544068
So is the Sine of ∠ 45 — 9,849855
to the oppoſite Side 35m — 11,393563
9,845147
Anſwer the Diſtance = 1,548416
is 35 Minutes the Bearing = N.W. by N.



Suppoſe a Ship ſails N.W. by S. 50l. then S.S.E. 45l. & then forced back by bad weather to the firſt Place from whence ſhe ſailed, required her ſecond Courſe and laſt Courſe back.

Oblique Sailing

As the Side ... 66 = 1,929419
: Radius ... 90 = 10
:: Side 2 ... 30 = 11,699970
: Tangent of the oppo. ∠ = 30.24 = 9,769551



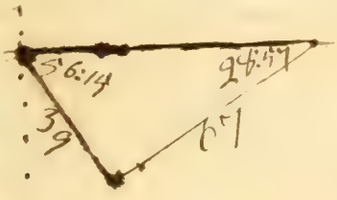
As the Sine of ∠ = 30:28 = 9,705941
: the Side ... 60 = 1,778151
:: the Radius ... 90 = 10,000000
: to its oppos. Side = 41 = 1,993930

Ans. Her 2d Course
E by S 1/4 S. her 2d Course is
W by N 1/4 N

Ex. 5. A Ship in 46:30 N. Lat. sails in to the Harbour of Rotats who takes away the Compass after which she sails between S.W. by W. & W.S.W. 70 Miles & then meets with a man of war who from the Ship's Lat. sailed S. & by E. 39 Miles & then by the Parales required the Course the Man of war must steer to meet them.

As the Side ... 67 = 1,826075
is to the Sine of ∠ = 56:15 = 9,919646
so is the Side ... 39 = 1,591065
to its oppos. ∠ = 24:57 = 1,684354
9,994719

1,319646
1,591065
11,591913
1,684354
9,644934



Plane Sailing

Exc. 1. Sailing along the shoure I see two Capes the first bore N.° the second N. E. N. having sailed N. W. b. N. 9 m. the first bore E. b. S. the second S. b. E. Required the Bearings & Distance of them from each other.

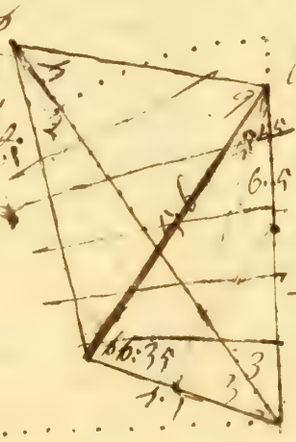
4 pts & 11 Points		9,119446
1. of Difference	9,991674	the Diff. of Lat.	0,954242
is to the Diff. of Lat.	0,954242	:: 2 Points	9,602946
:: 4 Points	9,602946	is to opposite side 4.1	10,137092
is to opposite side 6.5	1,086727		9,119446
	9,771719	6.5	0,617236
	0,812153	12.6	
		2.1	

As the Sum of the two sides 12.6 — 1,025306
is to their Difference 2.4 — 0,380211
so is the Tangent of the half Sum of the unknown Angles 25° — 9,669546
to the Tangent of half the Difference of the two Angles — 62.1 — 10,074963

	10,300057
	1,025306
	9,274751

Required their Distance from each other — 4.6

The Bearing of the second from the first is E. S. E. the Bearing of the first from the second is South 4.1

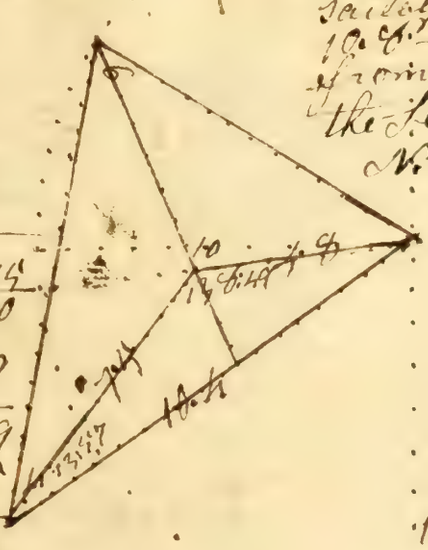


As Sine of ∠ 45.55 — 9,854323
the side — 4.1 — 1,612784
is to the Sine of ∠ 67.30 — 9,964814
to the opposite side — 4.6 — 1,732076

180	
112.49	As the Sine of the ∠ 112.49 — 9,968236
41.11	is to the side — 10.45 — 1,019033
	:: Sine of ∠ — 41.11 — 9,818269
	to its opposite side 17.5 — 1,237302
	9,818436
	0,671766

Plane Sailing

Ex. 7. Three Ships sail from one Port, the first sails S. W. by W. the second W. by S. ½ S. & the third S. W. by W. ½ W. then the first & second Ships Distance & Bearing from each other, the first & third Ships Distance & Bearing from each other, & the second & third Ships Distance & Bearing from each other required.



As the Sine of the 2 Pts — 9,849485
: the Side — 8 — 0,903090
: Sine of 6 Pts — 9,965614
to its opposite side — 10,868704
— 9,849485
10.4 — 1,019220

As the Sine of 10 Pts — 9,965614
to the side — 8 — 0,903090
: the Sine of 3 Pts — 9,744739
to its opposite side — 10,647829
— 9,965614
4.8 — 0,682214

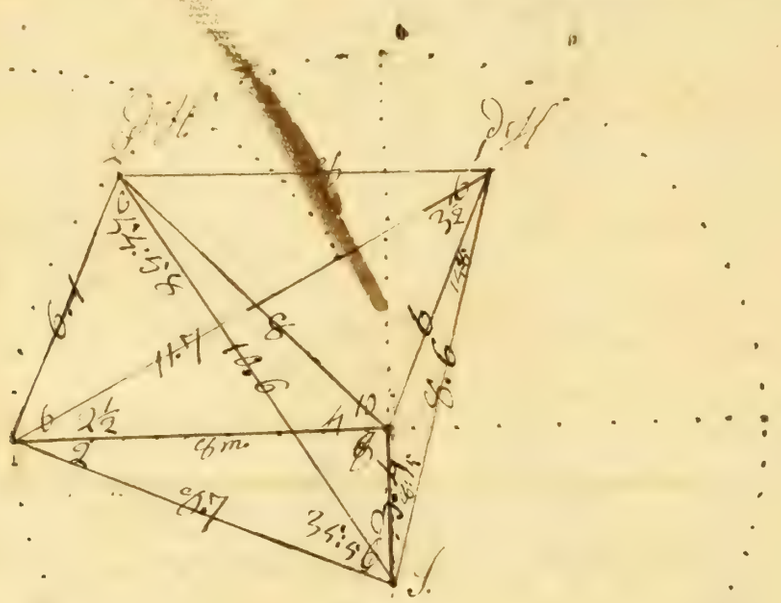
Answer the first Ship sailed 10.4 Miles, the second sailed 10.8 Miles, their Distance from one another is 7.4 & the second Ship bears E. the second N. E. ½ E. & bears E. by N. 1½ E.

As the Sum of the two Sides is to their Difference
: their Difference
:: Tangent of half the Sum of the two opposite ∠s 76 — 14
: the Tangent of half the Diff. of those ∠s 14 — 9
— 62:26

15 — 1,181844
5.6 — 0,748188
10,929969
10,678657
1,181844
1,181844
11,363501
1,181844
10,614766
10.4
10.8
15.2
5.6
0,748188
10,614766
11,362954
1,181844
11,544798
1,181844
10,362954
10,362954
0,000000

Oblique Sailing

C.C.J.K. Sailing along Shore, I see two Headlands the the Eastermost bears N.E. & the Westermost N.W. & me but the same time an Island bears S.b.E. then after I had sailed west 6 M. the first bore N.E.b.E.½E. the 2. N.E.½N. & the Island S.E.b.S. from me: the Bareing & Distance of the Places from each other are Required.



As the Sine of ∠ 10 Pts
to the Sine of ∠ 39:22 ~ 9,602281
is to the Side ~ 6 ~ 0,903090
so is the Sine of ∠ 10 Points or 67:30 9,964614
to the opposit Side 11.7 = 10,868705
9,602281
1,066424

As the Sine of the ∠ 67:30 ~ 9,964614
is to the Side 6 m ~ 0,903090
so is the Sine of ∠ ~ 45 ~ 9,649495
to the opposit ∠ 6.1 10,752585
9,964614
0,787971

As Sine of ∠ 67:30 ~ 9,964614
: the Side ~ 6 ~ 0,903090
:: Radius ~ 90° ~ 10,
: its opposit Side 67½ 9,903090
9,964614
0,938476

As the Sine of ∠ 67:½
: Side ~ 6 ~

45
9,548
54:548
39:5

As the Sum of the two Sides 14.8 ~ 1,170262
is to their Difference 2.6 ~ 0,414973
so is the Tangent of half the Sum of those ∠s 45 10,
to the Tangent of half the Diff. of those ∠s = 9:5 10,414973
1,170262
9,244711

Oblique Sailing

As the Sine of ∠ 35:5 — 9,759492
: the Side ~~of~~ ∠ 6.1 — 0,778330
:: Radius — 90 pts — 10
: its opposite Side 10,6 — 1,025838

10,778533
9,759492

As the Side 8 — 0,903090
: the ∠ 6 pts — 9,965615
:: the Side 8 — 0,903090
: to its opposite ∠ 6 pts — 9,965615

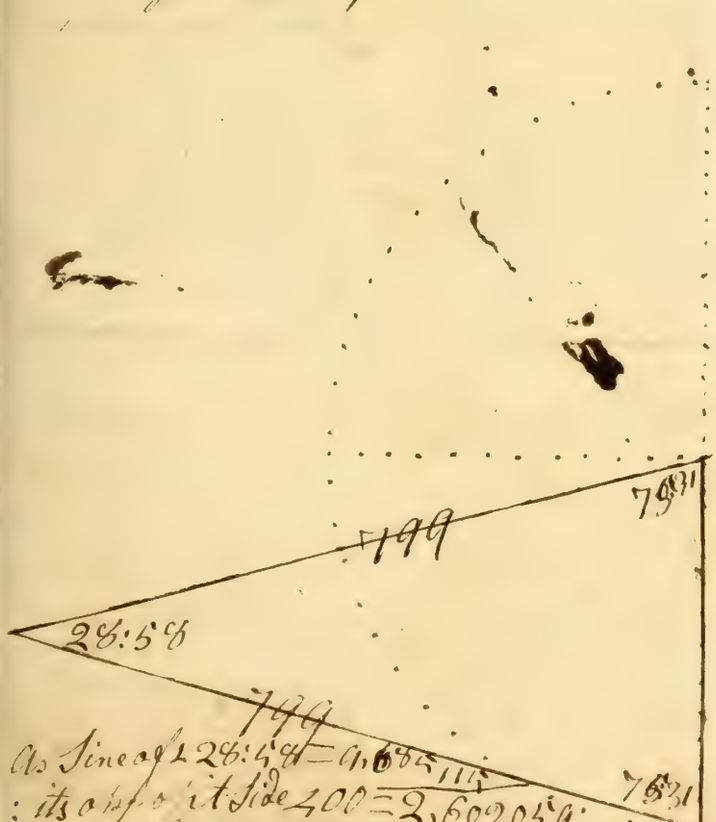
10,868705
0,903090

As Radius 8 Points — 10
: the Side 8,7 — 9,939869
:: the Sine of ∠ 2 pts — 9,682640
: its opposite Side 7,4 — 0,622709

as the Sine of ∠ 3½ Points — 9,862281
: the Side 8 — 0,903090
:: the Sine of ∠ 2½ Points — 9,673269
: its opposite Side — 9,438359

As the Sum of the two Sides — 9,4 — 0,977126
: to their Difference — 2. 6 — 0,414973
:: Tangent of Half the Sum of the base two ∠s — 11:15 — 9,291662
: the Tangent of Half their Difference — 9,713634

Ex. 9. The Wind being South & a Ship Bound to a Port 400 Leagues Directly Towards the Windward can lie no nearer than 75°:31' or 6¾ Points from it; Required her Distance upon each Tack to the said Port.



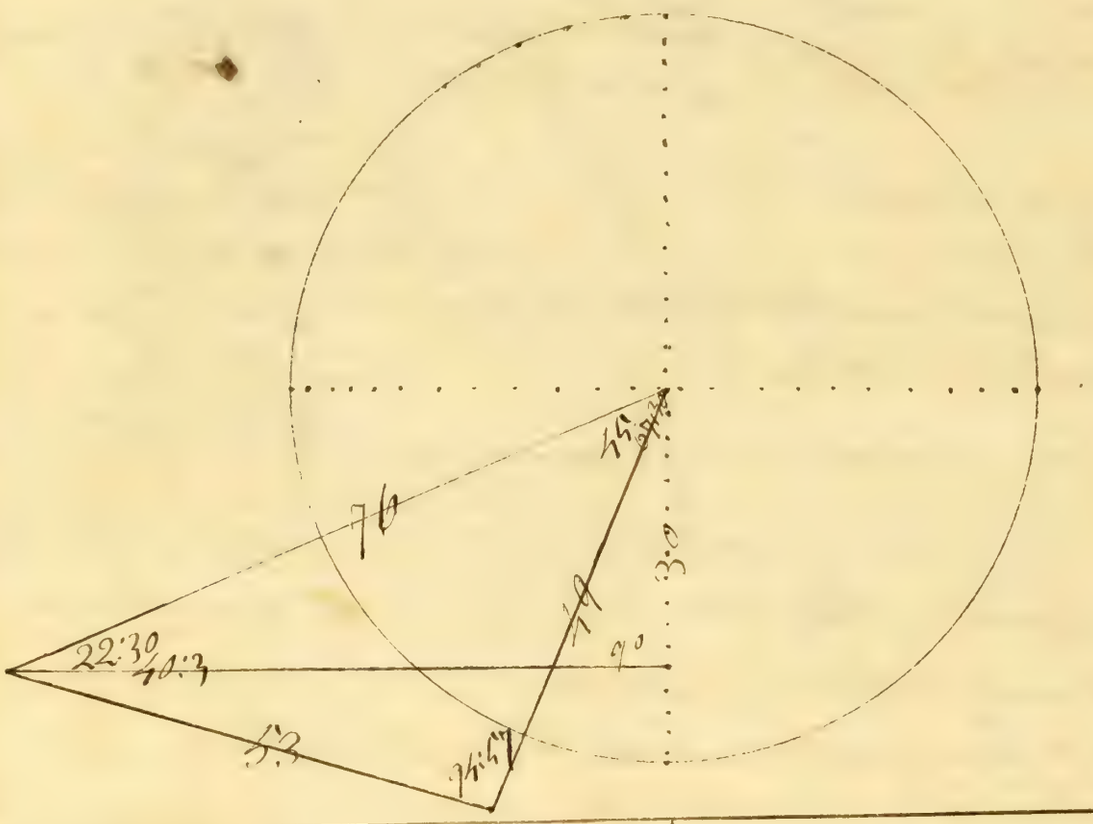
As Sine of ∠ 28:58 = 9,684115
: its opposite Side ∠ 100 = 2,602059
:: Sine of ∠ 79:31 = 9,993974
: to its opposite Side = 199 = 2,299033

1,677115
3,902716

Answer
The nearest Tack
Tack 199 L

Oblique Sailing

Exa. 10. A Ship sails from a certain Cape & in 24 hours by the Log runs S.S.W. 49 m. in a current Setting between the N.W. & W. & then the Cape bears E.N.E. & by Observation the Ships Diff. Lat. is 30 m.; Required the Current's Motion, upon what Point & Corns she & how fast?



As Sine of ∠ 22:30 — 9,582640
: the Side — 30 — 1,477121
:: the Radius — 90 — 10,
: its opposit Side = 76 — 9,582640 / 1,942761

49
76
125 Sum
27 Diff.

180
45
135
67:30

As the Sum of the two Sides is to these — 125 — 2,096910
is to these Diff. — 27 — 1,431364
so is the Tangent of Half the Sum of the two ∠s 67:30 — 10,376277
to the Tangent of Half the Diff. 27:27 = 9,710641

2,096910
9,710641
9,400069
9,717230

As Sine of ∠ — 40:3 — 9,808519
: the Side — 49 — 1,690196
:: the Sine of ∠ — 45° — 9,849485
: its opposit Side — 53 — 1,731162

Answer the Current's Motion N.E. & W. 53 m. the Point that Compass N.E. & W. the Distance it runs in 24 Hours is 79 m.

Mercator Sailing

The Second Part of Navigation or the Doctrine of Plain Right Angled Triangles, applied in Problems of Mercator Sailing.

In order to convey a just Idea of this Kind of Sailing we must observe that since the Earth is a Globe, the Degrees of Latitude will indeed be all equal, but as the Meridians all meet and intersect each other at the Poles, the Degrees of Longitude must Necessarily grow less the farther you recede from the Equator towards the Pole. and hence the Plain Chart, which supposes the Earth's Convex Superficies is very far from being True, the Proportion in which the Degrees of Longitude on the Parallels decreas is that of the Cosine of the Lat. of the Parellels to the Radius, or that of the Radius to the Secant of the Latitude.

Hence to delineate the Parallels & Rumb Lines as well as Meridians. on a Plain (with exactness) in Right Lines the Degrees of Lat. must be enlarged in the above Proportion towards each Pole, so that the Degrees of Longitude on the Parallels may be equal to that on the Equator, & also the Meridians all lie Parallel; & the Proportion of Easting & Westing Northing & Southing may be the same.

Hence in Mercators Chart, the Length of a Degree, or any other small Arch on the Meridian thus enlarged is everywhere equal to the Secant of its Latitude. by the continual addition of these Secants or enlarged Degrees, is framed the Table of Meridional Parts.

Hence as the Meridians are Parallel & the Rumbs strait strait Lines, the Ships Way, Course, Diff. of Lat. & Departure, will form a Right Angled Triangle, which may be solved by the Rules of Plain Trigonometry.

This Method will give the True Distance, Bearing Diff of Long. &c. of Places as will appear in the following Problems.

Meridional Sailing

Problem 1. To find the Diff. Lat. of two Places in Meridional Parts.

Rule. The Lat. of one } Name, the { Diff. / Sum } of the Meridional
contrary }
Parts found in the Table answering to the Degrees & minutes
of each Places Lat. is the meridional Difference of Lat.

Required. { &c. / { The Lizard and Barbados, their
Meridional Diff. Lat.

Lizard } Lat { 50: 00 / 13: 00 } North Meridian Parts { 3475 / 787 }
Barbados } { 13: 00 } { 787 }
Subtract gives the Meridian Difference 2688

Problem 2. { The Lat. & Long. of two Places given; to find
their Course & Distance.

&c. { What is the Course & Distance from the Lizard to
Barbados.

Lizard } Lat. { 50: 00 / 13: 00 } Merid. Parts { 3475 / 787 } Long. { 5°.24 / 57:54 } W.
Barbados }

Diff. Lat. — 37: 00 — Merid. Diff. Lat. 2688. Diff. Long. 52:30 W.
60 60

Diff. Lat. Minutes, 2220, 00. S. — — Diff. Long. Minutes, 3150 W.

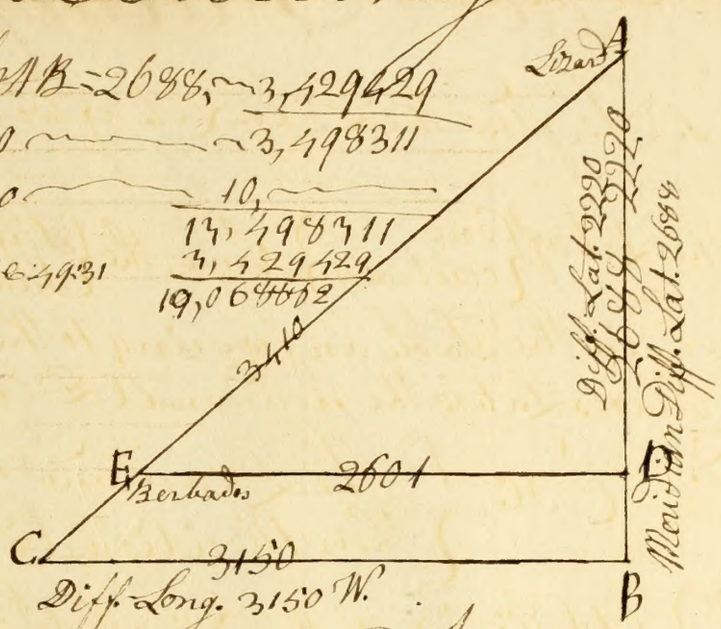
To delineate this, first draw a Meridian Line & Lay two 2688 Minutes
from C (Representing the Lizard) to B Southerly for the Merid.
Diff. Lat. — Draw B C perpendicular to C B. & thereon
Lay 3150 Mi the Diff. Long. westerly from C to E from C to G
Draw a line which constitutes right ∠d Δ A B C.

Then upon your Meridian Line make A D Equal to 2220 Minutes
the Proper Diff. of Lat. & drawing D E parallel to B C. to cut C
in E. A E will be the proper Dist. from the Lizard to Barbados.
& then the ∠ C A B is the true Course from the Lizard to Bard
Barbados. C B the Diff. Long. & A B the Merid. Diff. Lat. & A
the true Diff. Lat. To resolve this by Trigonometry. There
are two right ∠d Δs. A B C & A D E. the Proportions here
are the same as in right ∠d Δs.

Mercator Sailing

As the Meridional Diff. AB = 2688 — 3,429429
is to the Diff. Long. BC. 3150 — 3,498311
so is the Radius — 90 — 10,
To the Tangent of the Course = 49.31 — 13,498311
3,429429
19,068882

~~As Diff. Lat. 40.28~~
~~is to Sine of Lat C 90~~



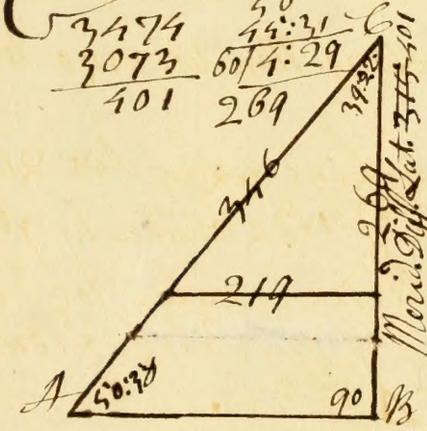
As the Sine of Lat C 40.29 — 9,812396
Diff. Lat. 2220 — 3,346353
: Radius — 90 — 13,346353
9,812396
To the Side EA — 3410 = 3,533957

ANSWER the Distance is from the Lizard to Barbadoes is 3410 M. the Direct Course S.W. ~~by~~ ½ W.

Problem. 3. The Lat. & Course given, to find the Diff. of Long. & D.

A Ships sails from the Lizard, & makes her Course (when Variation Leeway &c, are allowed for) S.W. by S. ½ W. and then by Observation, is in Lat. 44:31 N. I demand her Diff. of Long. & Long. she is in?

3474 / 3073 / 401 — 50 / 44:31 / 60 / 4:29 / 269



As Sine of Lat A 50:38 — 9,888237
: Side — 269 — 2,426752
:: Radius — 90 — 10,
: Distance run = 346 — 12,426752
2,538515

As Sine of Lat A = 50:38 = 9,888237
: Side — 269 = 2,426752
:: Sine of Lat B — 39:22 = 9,802241
: D. Long. she is in — 12,229033
= 219 = 2,340796

ANSWER the Distance run is 246 M. The Long. she is in is 219 W.

Mercator Sailing.

Whatsoever